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'*Knowledge is proud that he has learned so much,*
Wisdom is humble that he knows no more.'—COWPER.

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Hygiene.

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FOOD—(*Continued*).

Alimentary substances differ in the number of elements which each contains; one is more solid than another, it may contain more carbon, or it may have a larger proportion of oxygen and hydrogen combined, existing in the form of water, or in chemical combination with the carbon. Popularly, liquid matters are considered to belong to drink rather than to food; but this is not a scientific division, for that which is a food may yet have nine-tenths of its weight water. Food and drink is not therefore a good classification. Attempts have been made to divide articles of diet into organic and inorganic foods; but water is inorganic, and it enters into the constituent parts of almost all organic compounds. A more definite arrangement has been made by dividing them into nitrogenised and non-nitrogenised foods, carbon, oxygen, and hydrogen in varying proportions forming the latter class, whilst the former have in addition to these, nitrogen, and some other of the elements which have been previously mentioned. This classification, which is Liebig's, was founded upon the idea that nitrogenised foods built up the body; and he styled them, '*plastic elements of nutrition*,' whilst he termed the non-nitrogenised foods, '*elements of respiration*'; but it has been shown by more recent physiological enquirers that nitrogenised compounds do assist to produce heat, and that tissue-forming materials leave hydrocarbons as *débris*, which may be used up in the production of heat. So fat is a non-nitrogenous substance; it belongs to what Dr. Pavy calls the *calorifacient* or *heat-producing* group of foods; but it is necessary to the production of some tissues, and ranks with the 'plastic elements of nutrition,' so that Liebig's classification fails. A chemical or physiological division into groups, which shall be correct, is not practicable; but the simplest classification may be taken as follows—viz. (1) *Inorganic*. (2) *Nitrogenous principles*. (3) *Fats or hydrocarbons*. (4) *Starches, sugars, carbohydrates*. (5) *Acids and alcohols* derived from changes which may take place in Class 4. These five classes include all the articles which can in any way be considered in the light of alimentary substances.

Inorganic Foods.—The inorganic alimentary principles consist for the most part of *water* and *mineral salts*, which latter may be in solution in the water or in chemical combination with organic matters. The presence of *water* is essential for the changes which are constantly taking place in the molecular condition of organic life. Without it no vital activity can arise, but mineral material is also absolutely necessary for the continuance of molecular activity. The processes called *endosmose* and *exosmose*, and which are always associated with cell-production, could not be continued if it were not for the changes which are produced in the densities of liquids on the principle of *osmosis*. This is a term which is applied to the passage of fluids through membrane, the membrane acting as a septum between fluids of different densities and different chemical constitutions. Thus, if ordinary bladder be placed between water and alcohol there is a current from the water to the alcohol, because the membrane as well as the alcohol has a great affinity for the water. It is probably partly by reason of this principle that absorption, assimilation, and secretion are perfected in living tissues, saline solutions of varying densities, with organic matter, assisting to determine the directions in which the fluids should travel, and bringing about those chemical conditions upon which the development of pseudo-galvanic or nerve excitation may take place, whilst it is intimately connected with the changes which arise in the blood-current in the lungs, for the blood corpuscles, by their affinity for oxygen, take in that gas and give up in exchange the CO_2 which they contain in excess. The corpuscles then carry the oxygen gas to distant parts of the organism and attract carbon into their structure in exchange for oxygen; heat is given out by the condensation which ensues, and thus temperature is kept up. Other chemical changes take place in the constituent elements of the blood: salines and other mineral particles, such as the phosphates, are appropriated by this or that organ, and the incessant activity which is styled 'vital energy' is maintained. One of the most important mineral elements in organic life is phosphate of lime. Its combination with nitrogenous matter is so intimate that the greatest difficulty is experienced in separating them. If the separation is

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effected the compound is destroyed. It seems as if phosphorus, in combination with lime, was absolutely essential to the development of vital activity in all cell-growth among the higher organisms. The chief saline principles are combinations of lime, magnesia, potash, soda, and iron, with chlorine, phosphoric acid, carbonic acid, and, in a slight degree, sulphuric acid. It is usual in conducting an analysis to incinerate the body to be examined, and then to analyse the ash, but this is not advantageous, except it be carried out in combination with other processes, for the carbon is driven off as carbonic acid, and the saline principles, under the elevated temperature to which they are subjected, occupy combinations which are different to those which they hold in the living tissues. These mineral elements occupy different places in the living organism, for they cannot be made to replace one another. Soda will not fulfil the proper requirements when potash is wanted, and lime cannot take the place of magnesia. Phosphates and potash salts are more abundant in the blood-corpuscles, whilst it is the chloride of sodium which is most abundant in the serum. The processes may be seen at work in the changes which take place in the common egg. The phosphorus which is present in the yolk becomes oxidised and converted into phosphoric acid. This reacts upon the shell, dissolving the lime and conveying it into the circulation of the chick, thus assisting in forming the bony skeleton of the fowl. The value of food will depend, to some extent, upon the kind of mineral matter which enters into its constitution, and in the preparation of food for the purposes of life, this view of the matter is but too often forgotten. Meat soaked in water and boiled is less nutritious than roasted meat, for some of its salines have been abstracted; and roasted potatoes, for the same reason, are more nutritious than boiled. But it is the staff of life, viz., household bread, which is depreciated most by the fashion with which which it is dealt with as flour. Most of the salines and nearly all the nitrogenous matters of wheat are contained in the outer part of the seed, and are taken away by the millers. Liebig has asserted that an immense number of persons could be fed upon the same quantity of wheat, if it were possible to persuade the people of the advantages which would arise from the use of unbolted flour, that is, of flour from which the glutinous matter of the outer skin has not been removed. The agitation which has been set on foot by Miss Yates, for the promotion of information among the people upon this point, is worthy of notice; for, although I am not inclined to go as far as Liebig in his views upon this point, we can obtain the missing ingredients from other articles of food, which, if not consumed, would be otherwise wasted or not produced; yet, for the benefit of the lower classes generally, it is highly important that they should not regard white bread as a better article than the brown, for the brown contains the larger portion of the mineral and glutinous part of the corn. It is the presence of these ingredients in wheat which gives its greater value over rice as supplying 'plastic elements of nutrition.' Rice is the least nitrogenous of all the cereals, and has scarcely any phosphate in its composition; it goes well with highly plastic food, but it cannot be taken as the only food for any length of time, without evil resulting to the constitution from its use. This example shows the necessity for mineral matter in the daily food. At the same time bran is not to be used as an exclusive diet, for the particles of which it consists will irritate the bowels and set up diarrhœa, if partaken of too freely. This action indicates one of the uses of the outer skin of wheat in nature, viz., to assist in regulating the bowels, but, like everything else, it is injurious if taken in excess.

Nitrogenous Aliments.—Nitrogen forms four-fifths of the atmosphere, but as a gas it is simply noted for its negative properties; it seems incapable of doing anything. But when it has been brought into combination with other elementary bodies by the aid of vital activity, we get organic nitrogenous matters which are anything but negative in their powers. Carbon, hydrogen, oxygen, having entered into combination with nitrogen, by means of vital activity, the so-called *proteine* compounds are formed, such as *albumen*, *fibrine*, *caseine*, and their modifications, viz.: *vitelline*, *globuline*, *syntonine*, *gelatine*, *chondrine*, etc.

It is very important to determine the nutritive value of different articles of diet: attempts have been made to fix standards by which the value of different kinds may be calculated, so that that which is economical may be differentiated from that which is wasteful, and proper supplies of food afforded to large establishments, such as schools, hospitals, asylums, etc., or even to armies in the field.

A calculation has been made which has been based upon the supposition that a man requires 1220 grains of nitrogenous matter every day to keep him in health; but this is unsound, because some foods which are acknowledged by experience to be valuable, are found by analysis to be defective in these qualities, and it has also been discovered that work can be done without nitrogenous food at all. Other tables have been prepared, which are based upon the quantity of nitrogen in the dried substance; but in this calculation no account is taken of the indigestibility of the dried material and of the fact previously stated. Another method has been followed, in which the proportions of nitrogen and carbon have been estimated, and these have been compared with the proportions which are thought to be required by an able-bodied man as a standard diet, but before this can be satisfactorily arranged, we must consider the functions of food, that is, the reason why food is necessary. Its ultimate destination is for the manifestation of force, and in this operation it is reduced, more or less, to more simple forms, viz., carbonic acid, water, and ammonia. The forces which are produced are: (1) heat, and (2) motion. With the development of these powers, we have intimately associated those functions of the body which are involved in development and growth, excretion and decay. A consideration of these points, shows at once the difficulty which is involved in a hard-and-fast line of classification based upon either chemistry or physiology, and we have to fall back upon general principles.

Chemists recognise several well-defined compounds, to which reference has already been made, but which are not capable of being synthetically produced—that is, analysis shows them to consist of so many molecules of C. H. O. N. with minute proportions of P. or S., but which no power in the laboratory enables us to reproduce them without the aid of vital force. At the same time, chemistry helps us to make calculations as to the value of diets, because we find that some nitrogenous aliments are characterised by yielding *proteine*

when subjected to the action of alkali and heat, whilst in other cases that body cannot be procured. This chemical fact gives two divisions—(1) *The albuminous*, or proteine principles; (2) *The gelatinous*. The former can be obtained from the vegetable as well as the animal kingdom, but the latter are only found in the animal world, as gelatine from bones and chondrine from cartilage; these latter also do not contain phosphorus.

All the nitrogenous aliments must undergo digestion before they can enter the system; and to enable them to be absorbed, they must be liquefied and transformed. It is according to the ease and rapidity with which these processes are effected, and the forces which can be obtained from the changes which their elements undergo, that their value as diets depend. The changes are promoted by digestion, commencing with mastication. The process is completed when the aliment has become changed into *peptones*, or '*albuminose*,' as it has been styled by Lehmann and Mialle.

Albumen in the coagulated form is dissolved, and is not again coagulable. Fibrine is dissolved. Caseine is curdled, and then re-dissolved; and gelatine is liquefied. All together by the aid of the gastric juice they form chyme, and mixing with the pancreatic and intestinal juices, go through the several changes which are terminated by the reception of the valuable part of the metamorphosed food into the current of the circulation, and the rejection of the useless *débris* from the body.

The value of the material supplied is regulated by its power to assist in (1) development; (2) renovation, and in (3) the promotion of the functions of vitality which are evolved in the manifestation of the attributes of the special senses.

Nitrogenous matter, forming the instrument of living action, is continuously disintegrated, and the resulting *débris* is being continuously removed. The smaller the *débris* the greater the value of the food, and the less the chance of the living machine being clogged by useless matter.

It used to be assumed that nitrogenous matter was the only source of muscular power, but it has been clearly shown that it is not produced by muscular destruction, as Liebig supposed, and that nitrogenous matter is not supplied through muscle, but, at the same time, it has been also proved that a plentiful supply of it does increase the power of an individual to perform muscular work. This is effected by the direct utilisation of the carbon and hydrogen which it contains. The elimination of urea, as the *débris* of nitrogenous matter is called, and which is excreted by the urine, is related to the quality of the food supplied, and not to the muscular work performed; and more recent observations tend to show that the metamorphosis takes place in the liver, and not in muscle.

(*To be continued.*)

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Friedrich Fröbel.

BY HIS PUPIL, HEINRICH HOFFMAN.

IX.

No wonder that so few were equal to such a task. Middendorf, however, had a wonderful way of maintaining his independence, and yet really submitting. And well he might; were there not so many points in which they were altogether one? That simple-minded earnest piety, that firm clinging to the eternal Bible truths, that unbounded love of mankind, that tender affection for little children, and last, not least, that sublime disinterestedness—were all equally marked in each of them. Middendorf was a child among children; Fröbel was spell-bound in the presence of a child. The sight of one, even at a distance, would act on him like a loadstone and would draw him a good distance out of his way, that he might have a friendly chat.

Their stay at Griesheim, however, was but short. There was nothing specially advantageous in that locality, beyond the fact that, of their six pupils (for Middendorf had brought with him Langethal's brother), three could live at home with their mother. But on the expiration of the customary privilege, allowed to widows of clergymen, Frau Fröbel purchased a small farm at Keilhau, a short distance west of Rudolstadt. A locality better adapted for educational purposes, it would certainly not be easy to discover. It is just as if nature had on purpose done her wisest and her best to produce a combination of the highest educational advantages. Fröbel's keen eye saw at once the realisation of his long-cherished dream, an ideal picture, that had often delighted his imagination. In June, 1817, they removed to the farmhouse. Frau Fröbel followed them some months later, when her own house had been thoroughly repaired.

The two friends had fully expected work, very hard work; but little did they know what difficulties they were to encounter.

We, in our days, are so accustomed to the luxury of school architecture and school appliances, that the tale of such privations, such extreme discomfort as they had to endure, seems to us utterly incredible. What with premises all but uninhabitable—if a mere carcase, minus doors, windows, and flooring, can in courtesy be called premises—a season of unprecedented misery, a disastrous famine raging over all Germany, and the utter absence of pecuniary resources—more than once they had to thank Mrs. Fröbel even for their bread—it is, indeed, a wonder how they held out.

But, fortunately, the woods abounded in wild strawberries and other delicacies of nature, and the boys were not over-fastidious. Did they not live in a country where fruit formed the principal ingredient of the meals of all the villagers, with the purest crystalline beverage fresh from the public well? a herring or a fried sausage being a private luxury enjoyed only by *paterfamilias*, when on market-days business called him to Rudolstadt.

New premises had to be built. In their poverty they endeavoured, as best they could with their own hands, to make their miserable abode habitable. They managed to obtain a schoolroom, rent free, compared with which all our grand palatial buildings are but pigeon-holes. It extended over an area more than two German miles in circumference, and it included mountains and hills and woods and rivulets, and the most delightful scenery; together with a library that was positively inexhaustible in its rich and wonderful treasures. And just as in an ordinary schoolroom, the broom and the cleaning brush are essential means of civilisation, so Middendorf took good care to leave behind him traces of culture, wherever he

came with his boys. Wherever there was a fine view there they erected seats. They eased the ascent of steep hills, laid out walks, planted trees. When they found a brooklet they searched for its spring, and bridged the stream at convenient points. On their return home with their rich harvest of flowers and curiosities of the mineral world, Fröbel was in his very element in classifying and naming the specimens thus collected.

At the fall of the year Langethal joined his friends, 'to share with them,' as Middendorf has it, 'the tormentingly delightful fate of a sublime sphere of labour amidst extreme exertions and almost incredible privations.' He was, indeed, an invaluable addition. A high reputation both as regards ability and character preceded him, for he had passed his theological examination with brilliant success. He was determined to devote himself heart and soul to Fröbel's work, and soon became a great favourite with the boys, who admired his manliness, his prowess in gymnastic exercise, his inexhaustible store of knowledge of history, and especially of the romantic lore of the Middle Ages.

Winter set in, and closed their delightful out-door schoolroom. They had to pull down and to rebuild with their own hands the stoves, to avoid being suffocated by the smoke. The pupils increased in number, and so did their cares and difficulties, but equally so their courage and their invincible ardour. The thought of earning money had never entered their minds. That they should share alike in the work, in the expenses, and in the earnings, was too much a matter of course to require much of an agreement Their faith in the idea that guided them was too great to be shaken by outward obstacles. It was enough for them that the young tree had struck powerful roots.

It was a matter of deep regret to them all when Frau Fröbel was obliged to leave Keilhau. She moved to Volkstädt, and Fröbel became, by purchase, owner of the farm.

All felt that a mother's superintendence of the increased household was now indispensable, but it required all the buoyancy of his spirit, all the courage and the unremitting faith of Fröbel to induce him to think of marrying. And yet, ever since his inspectorate at Berlin, he cherished in his innermost heart the memory of a lady, who had made a deep and lasting impression on him. It was Wilhelmine, daughter of Herr Kriegsrath, Councillor of War, Hoffmeister, a lady of high intellectual attainments, of the purest and noblest aspirations, large-hearted, and enthusiastically devoted to philanthropic labours.

In the company of her father, she had been a frequent visitor at the museum. Fröbel, in his animated manner, had there revealed to her a rich vein of intellectual treasures. The earnestness of his mind, his high aspirations, the grandeur of his character, could not fail to excite her admiration. He had never forgotten those interesting conversations, and frankly divulging to her his position and the state of his affairs, he ventured to ask her to his humble home. She readily consented to give up a life of comfort and luxury with the refined enjoyments of a high social circle, and joined him on his thorny path on the 20th of September, 1818, the anniversary also of her birth.

(To be continued.)

The New Class-Subject, 'Elementary Science.'

(What to teach, and how to teach it.)

BY RICHARD BALCHIN.

CONTINUING the scheme of lessons for Standard III., as given in the February issue of the PRACTICAL TEACHER, we now come to the subject-matter of Chapter VI., *i.e*, 'Useful Vegetables.'

LESSON 21.—CORN.

Objects exhibited: Specimens of common grasses, and of wheat, oats, barley, rye, and rice. Picture of flour-mill, etc.

(*Note.*—By pasting together sheets of cartridge-paper, I have made a number of paste-boards four feet long and eighteen inches wide. These are stiff enough to stand up on end before the class. On these cards I have mounted the specimens above alluded to, and they make really attractive objects. It is easy to obtain good specimens three to four feet high of such grasses as—'Triticum repens,' to compare with wheat; 'Holcus lanatus' fully out, to compare with oats; 'Poa trivialis' and 'Poa pratensis,' 'Lolium perenne,' etc. The specimens of corn are similarly mounted. In my old British school, over twenty boys had themselves made collections of grasses, named and mounted. But this was before the advent of the Code.)

First note that all kinds of corn are but cultivated grasses. Distinguish, by means of the specimens, between wheat and barley, and between oats and rice. Describe, conversationally, the operations—(1) Sowing, (2) Reaping, (3) Threshing, and (4) Grinding. Notice the general composition of this kind of food, *i.e.*, make a little wheaten dough; knead it in the hands while a boy pours over it a little cold water; the water runs off 'milky' in appearance, due to the presence of starch. What remains is mostly gluten, rather sticky. Pour a little of the milky water into a test-tube, and add a drop or two, not more, of iodine solution; the starch-water turns blue.

LESSON 22.—POTATOES AND GREENS.

Objects exhibited: A potato, a good 'hearted' cabbage cut in halves; picture of same; a bread grater, and iodine solution; also, if possible, a horse-radish and carrot.

For a good dinner, we generally have with the meat potatoes and greens. Potato, from the root of the potato-plant; not itself a root. Compare potato with carrot; the 'eyes' of the former are 'buds,' *i.e.*, leaf-buds. No buds on the carrot, only fibres. Hence, potato not a root, really a kind of underground stem, called a 'tuber.' Horse-radish, like the carrot, *is* a root. Show section of cabbage; really a great leaf-bud. Central stem (axis) trying to force its way up. If the cabbage 'runs to seed' it *does* so force its way up and bears flowers and seeds.

Wash out the starch from the potato, as described on page 116 of the 'Science Reader' for Standard IV.

Note.—The subject-matter of Lessons 23 to 27 is fully given in the 'Reader' for Standard III.

LESSON 28.—THE PLANE AND SYCAMORE.

Objects exhibited: Pictures of these trees; specimens of their leaves and of their fruits.

Carry on a conversation about the pictures, noting, 1st, the points of likeness between these trees, *i.e.*, both have smooth woody trunks and spreading branches; both large ornamental trees; leaves very nearly the same pattern in both; wood light-coloured and durable, easily worked. 2nd, Points of dissimilarity. The fruit of the plane quite unlike that of the sycamore. On the plane the flowers and fruits are in ball-clusters on pendulous stalks; two or three balls on each flower-stalk: to each flower in the cluster there is a seed-case, containing one or two seeds. The green flowers of the sycamore are thickly clustered around a pendulous stalk; not many of the flowers really producing seeds; sometimes only four or six in each cluster. The fruit is a pair of winged seed-cases, joined at their swollen ends. If such a pair be thrown up into the air, it spins round and round, hence the childish name—'dicky birds.' Plane trees are often planted in school playgrounds, or by the side of the road in large towns. They are on the Thames Embankment. This tree is a native of North America. It comes in leaf after the sycamore. The bark often peels off in cakes, leaving white patches on the trunk. The sycamore is really a maple, and should be called the sycamore-maple.

LESSON 29.—THE OAK.

Objects exhibited: Pictures of the oak—(1) A tree grown naturally; (2) A pollard oak, *i.e.*, one whose central stem has been cut for the purpose of inducing it to throw out branches around the section. Some oak-leaves and wood, acorns, oak-galls, and a sharp penknife. Also, if possible, an infusion of oak-galls, made by breaking up three or four of them and soaking in hot water; a little of the solution of sulphate of iron (copperas).

Compare the oak with the plane or sycamore (1) As to trunk: oak, rough, often gnarled; plane, smooth; trunk of pollard oak very large, often hollow. (2) As to shape of leaves. Oak not planted by road-side. Why? Very slow growth. Two kinds of flowers on the oak; only one kind comes to acorns. Compare vegetable marrow and cucumber. (Better not use the technical terms for these unisexual blossoms. Call the staminate flowers 'pollen flowers,' and the pistillate ones 'fruit flowers.') Seems to be two kinds of fruit on the oak-tree, *i.e.*, acorns and oak-galls. Oak-galls not a fruit. It is a case made by an insect, in which to lay an egg. Egg comes to a grub or maggot, which eats its way through the case and becomes a small fly. Cut open a few galls to illustrate this. Note that the steel knife is blackened. Put some clear infusion of galls in one test-tube, and some clear solution of copperas in another, pour the two together into a third tube, and so make black ink.

The subject-matter of Lessons 30 to 36 is given with sufficient fulness in the 'Reader.'

LESSON 37.—WATER FREEZING AND BOILING.

Objects exhibited: A thermometer; some ice and salt; can of water; a basin; a narrow test-tube. An empty oil-flask, and retort-stand. A spirit-lamp and a piece of pointed glass tube (*i.e.*, a pipette).

Carry on conversation about the thermometer. Note the freezing-point of water, 32°; this is not the freezing-point of all liquids—the mercury in the thermometer, for instance. Boiling-point of water, 212°; not shown on ordinary thermometer; not long enough. Heat of healthy body, 98°. Mix some broken ice and water; place the glass in the water; mercury sinks to 32°. Mix some broken ice and salt; mercury sinks below 32°. Place in this mixture the little test-tube, with a small quantity of water in it. The water is frozen—*i.e.*, ice and salt, a freezing mixture. Boil some water in an empty oil-flask over a spirit-lamp; describe the behaviour of water when boiling. To show how upward currents are produced, introduce a finely-pointed glass-tube, containing a little thick black ink, so as to allow a small stream of ink to run out into the water in the lower part of the flask. The ink will be carried upward, and for a time remain quite distinct from the water.

The subject-matter of Lessons 37 to 42 is fully given on pages 74 to 94 of the 'Reader' for Standard III. and on page 73 of the 'Reader' for Standard IV.

LESSON 43.—NATURE'S WORK.

Objects exhibited: Picture of a country scene during a storm, or during a shower; the one illustrating a rainbow will answer the purpose.

Allow the boys to talk freely about the picture; leading them to note (1) the downpour of rain and then its effects—*i.e.*, (*a*) washing the streets or roads; carrying away material to the gutters, then to the sewers, to the rivers, to the sea. The same with the general surface of land, *i.e.*, removing the land to ponds, or lakes, or river-deltas, or to the sea. (*b*) Clearing the air of impurities, such impurities being brought down to the earth to become food for plants. All such work is done independently of man. It is Nature's work. (2) Note that the rain comes from the clouds. Clouds are masses of water-vapour, which have been raised from the surface of the earth to the air by the sun. Sunshine, drying up the streets, etc., after a shower. Many tons of water fall as rain; therefore many tons of water lifted into the air by the sun. A great work. Not man's work; it is one of the great works of Nature. (3) Note the trees, grass, flowers, and corn all living, feeding, and growing. Mostly the work of the sun. The sun's heat brings out the buds and leaves of spring, forms the summer blossoms, and ripens the autumn fruits. Not altogether the work of man, who only assists in the great work of the sunshine and the shower.

LESSON 44.—'THE WORK OF THE SUN.'

First: Ripening Fruits and Seeds.

Objects exhibited: Picture of cornfield or orchard. An apple or orange. A grain of corn sprouting.

Show the sprouting grain. Describe the spring wheat appearing and growing, as the work of the spring sun. Then the hot sun of August ripens the grain. Note the difference between the fruit and the seed. Cut the apple open and show the seeds. Call the fruit the 'seed-case.' Give other illustrations of this, *i.e.*, show the seeds in the grape or the gooseberry. With such fruits as the apple, orange, plum, grape, etc., the 'ripening' is really the formation of sugar in the substance of the plant or fruit. Instance the terms 'grape-sugar,' 'cane-sugar,' etc. This 'sugar-making' is the work of the sun. Note that starch is formed before sugar.

(To be continued.)

Physiology.

BY ARTHUR NEWSHOLME, M.D. LOND.,

Gold Medallist and University Scholar, Physician to the City Dispensary.

CHAPTER VIII.—*(continued).*

The liver is situated under cover of the ribs on the right side of the body, fitting into the concave surface of the diaphragm. It is the largest gland in the body, measuring from ten to twelve inches transversely, and weighing in the adult an average of from fifty to sixty ounces. It is solid to the feel, and of a dull reddish-brown colour. It is imperfectly divided into a right and left lobe, and the right lobe shows three secondary lobes or lobules. The surface is covered, like that of most of the abdominal organs, by the peritoneum, and certain folds of the peritoneum form ligaments fixing the liver in position. Inside the peritoneum is a coating of areolar or fibrous tissue, which at the portal fissure (that is, the place where the portal vessels enter the liver) becomes continuous with a fibrous sheath, known as the *capsule of Glisson*, enveloping the portal vein, hepatic artery, and hepatic duct as they branch in the substance of the liver.

It will be convenient before describing the intimate structure of the liver to enumerate its vessels and ducts, and show how they are connected with the alimentary canal. On the under surface of the liver can be seen two small ducts which bring the bile from the substance of the liver. They join together to form the *hepatic duct* (Greek, *hepar*, the liver), as seen at *b*, Figure 39. The hepatic duct is joined at an acute angle by the *cystic duct*, which is one and a

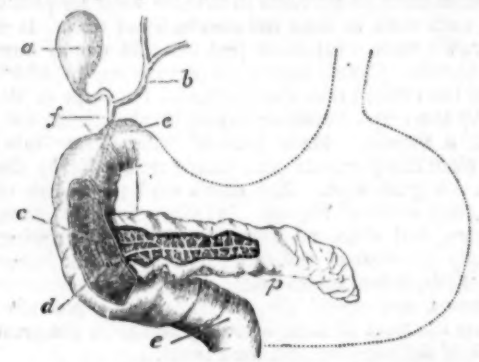


Fig. 39.—Showing relation of ducts opening into duodenum. (*a*) Gall-bladder. (*b*) Hepatic duct. (*c*) Opening of a pancreatic duct. (*d*) Opening of a tube formed by junction of common bile duct and a pancreatic duct. (*e*) Duodenum cut open to show orifices of ducts. (*f*) Common bile duct. (*p*) Pancreas, also cut across in part of its course to show the commencement of ducts.

half inches long, and brings the bile from the gall-bladder. The *gall-bladder* lies on the under surface of the liver, being fixed to it by areolar tissue. It forms a reservoir in which bile is collected until required in the intestine; and it is probable that the stimulus furnished by the passage of food over the orifice where the common bile duct opens into the intestine, is sufficient to cause a contraction of the involuntary muscular fibres in the wall of the gall-bladder, and consequently an expulsion of its contents.

The *common bile duct* formed by the junction of the hepatic and cystic ducts, is nearly three inches in length, and passes down to pierce the duodenum near its middle, running obliquely for three-quarters of an inch between its coats, and finally entering the intestinal canal.

The liver is supplied with blood from two sources—the portal vein, and the hepatic artery. The portal vein brings the blood from most of the alimentary canal, and from the spleen; it enters the substance of the liver along with the hepatic artery and the hepatic duct; and the three together run in small canals, called *portal canals*, which are each invested by a portion of Glisson's capsule.

The substance of the liver is made up of a multitude of minute *lobules*, varying from a half to one line in diameter. These are polyhedral masses not completely isolated from one another; each one consisting of a mass of cells penetrated by a close network of blood capillaries, and by the capillary commencements of the bile ducts. The cells composing the main mass of the lobules are from $\frac{1}{1000}$ to $\frac{1}{800}$ inch in diameter, polyhedral in shape, each containing a clear round nucleus, and one or two nucleoli. The cell substance is granular and of a faint yellowish tinge; occasionally fat globules are also visible. The cells are packed round the vessels, and when seen in a cross-section appear as if radiating from the centre of the lobule towards its circumference.

The exact nature of the origin of the bile ducts is somewhat doubtful. It has been already stated that the larger bile-ducts accompany the branches of the portal vein, and ramify with them in the outer part of each lobule. There can be little doubt, however, that they penetrate the substance of the lobule, and that here biliary capillaries are formed, which between the lobules form minute biliary ducts, and join with others, finally leaving the liver as the hepatic ducts. It is still doubtful whether these biliary capillaries have distinct walls of their own, or are mere channels between the individual cells of the lobule.

The portal vein in its course through the liver breaks up into capillary vessels, an event which is only paralleled in the case of the veins leaving the Malpighian tufts of the kidney. It first gives off small branches, accompanying those of the hepatic duct, which divide again and again between the lobules, and are hence called the *inter*-lobular veins. From these small veins a dense capillary network penetrates the substance of the lobule, which gradually collects itself into a larger vessel at the centre of the lobule, called the

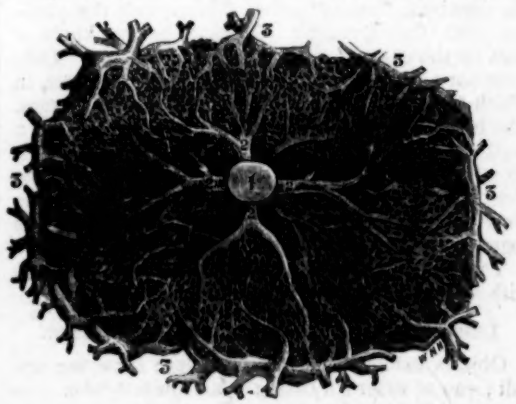


Fig. 40.—Cross-section of a lobule of the human liver, magnified six times.

1. Intra-lobular vein cut across. 2. Its smaller branches gathering blood from the capillary network. 3. Inter-lobular veins, with ramifications passing inwards to form the capillary network.

intra-lobular vein. This arrangement is well shown in Figure 40. The small intra-lobular veins discharge their contents into veins called *sub*-lobular. These join together and form the branches which finally leave the liver by two or three trunks known as *hepatic veins*, and then empty their contents into the inferior vena cava.

Thus we have—

1. PORTAL VEIN.
2. Inter-lobular Veins.
3. Capillaries.
4. Intra-lobular Veins.
5. Sub-lobular Veins.
6. Hepatic Veins.
7. INFERIOR VENA CAVA.

The hepatic artery is distributed in a similar manner to the portal vein, its function being to supply nutriment to the tissues of the liver.

The Pancreas lies within the curve formed by the duodenum, and behind the stomach. It is usually from six to eight inches long, and its weight is variable, but usually about two and a half to three ounces. In its general characters and minute structure, the pancreas closely resembles the salivary glands, belonging to the class of compound racemose glands. The duct by which its secretion is poured into the alimentary canal is well shown in Figure 39. It runs through the walls of the intestine side by side with the common bile duct, and terminates by a common opening in the mucous membrane. Occasionally part of the sacculi open by a duct at a separate point of the duodenum.

(To be continued.)

—o—

Recent Inspection Questions.

[*The Editor respectfully solicits contributions—all of which will be regarded as* STRICTLY PRIVATE—*to this column. For obvious reasons, it cannot be stated in which district the questions have been set.*]

Arithmetic.

STANDARD I.—DICTATED.

(1)	(2)	(3)	(4)
609	47	605	915
8	824	386	618
76	90		
90	706	219	297
849	7		
1632	1674		

STANDARD II.—DICTATED.

(1)	(2)	(3)
8491	20579	11)55396
495	708	5036
7996	14569932	

STANDARD III.

(1) A lady went a-shopping with £10 in her pocket. She spent 19s. 6d. in groceries, 7s. 9d. in boots, and £5 0s. 11d. in dresses; how much money had she left? Ans. £3 11s. 10d.

(2) Divide ninety-three thousand one hundred and two by ninety-five. Ans. 980—2.

(3) £567 18s. 6½d. + £4920 6s. 10d. + £51783 19s. 11¾d. + £2202 16s. 0¼d. + £2867 15s. 7½d. (Given partly in words). Ans. £62,342 17s. 0d.

(4) £9001 14s. 9¼d. − £183 15s. 10¾d. (words). Ans. £8817 18s. 10½d.

STANDARD IV.

(1) Take 5000 farthings from 5000 shillings. Ans. £244 15s. 10d.

(2) Out of 16 cwt. of butter, a grocer sells 27 lb. daily for 5 days. How much has he still on hand? Ans. 14 cwt. 3 qrs. 5 lbs.

(3) Divide £8 8s. 0½d. equally among 109 men; how much will each get? Ans. 1s. 6½d.

(4) Bring 17 sq. yds. 8 sq. ft. 120 sq. ins. to sq. ins. Ans. 23,304 sq. ins.

STANDARD V.

(1) Add together $\frac{1}{3}+\frac{2}{5}+\frac{3}{8}+\frac{4}{7}$, and from the sum take $1\frac{1}{12}$. Ans. $1\frac{41}{840}$.

(2) 9461 articles at £11 14s. 3½d. each. Ans. £110,831 13s. 5½d.

(3) If a man's salary for a year be £136 17s. 6d., how much would he require for 25 days' service? Ans. £9 7s. 6d.

(4) If 25 horses cost £1076 10s., what would 75 cost? Ans. £3229 10s.

STANDARD VI.

(1) $(13\frac{1}{2}$ of $\frac{5}{9}) + (1\frac{2}{7}$ of $\frac{2}{3\frac{2}{5}}) - 7\frac{2}{3}\frac{4}{5}$. Ans. $\frac{1}{2}$.

(2) Bring $\frac{9}{11}$ of £1 2s. $11\frac{1}{3}$d. to the fraction of $\frac{3}{11}$ of £3 12s. $1\frac{1}{3}$d. Ans. $\frac{3}{4}$.

(3) Multiply ·0132 by ·021, then divide the result by ·00084. Ans. ·33.

(4) Find the simple interest of £10 3s. 4d. for $3\frac{1}{2}$ years at $2\frac{1}{2}$ per cent. Ans. 17s. 9½d.

STANDARD VII.

(1) In a dictation exercise given to a class of 36 boys, $\frac{1}{6}$ had no mistakes, $\frac{1}{4}$ had one each, $\frac{1}{3}$ had two each, $1\frac{1}{2}$ had three each, and the remainder had four each. Find the *average* number of errors. Ans. $1\frac{11}{18}$ each.

(2) In a school of 400 children 31 per cent. are boys, 41 per cent. are girls, and the rest infants. Find the number of each. Ans. 124 B., 164 G., 112 I.

(3) A dealer buys toys at 10s. a gross, and sells them at a penny each; find his gain per cent. Ans. 20 per cent.

(4) The discount on a bill due 10 months hence at 6 per cent. is £70. Find the amount of the bill. Ans. £1470.

Domestic Economy.

STAGE I.

(1) What is flax? What materials are made from it?

(2) What advantages have knitted stockings over woven ones?

(3) What should be done with the lines and pegs after the clothes are taken in from the drying yard?

(4) What kind of clothes should be worn in summer, and what kind in winter? Why?

(5) What foods contain respectively albumen, fibrine, gluten, and casein?

(6) What foods contain fatty substances?

ANSWERS TO

Pupil Teachers' Examination Papers.

FEBRUARY 23.

FIRST YEAR.

Pupil Teachers at end of First Year.

Three hours and a half allowed.

Arithmetic.

MALES.

1. Define a fraction. Explain why a fraction is decreased by increasing the denominator, and why $\frac{1}{7}$ is $= \frac{6}{7 \times 2}$.

A fraction denotes a part or parts of a unit; it is expressed by two numbers placed one above the other, with a line drawn between them; the lower being called the denominator, and the upper the numerator: thus $\frac{5}{7}$ denotes that the unit is divided into seven equal parts, and two of these parts are taken to form the fraction. Every fraction represents a quotient, the upper number being the dividend, the lower, the divisor. If the denominator be increased, the fraction itself is decreased, for whatever be the meaning of $\frac{1}{7}$, the fraction $\frac{1}{7 \times 2}$ or $\frac{6}{8 \times 2}$ means only half as much, because here the dividend remains the same and the divisor is doubled, wherefore the quotient is diminished one-half.

If the numerator and denominator be both multiplied or both divided by the same number, the value of the fraction remains unaltered.

In the fraction $\frac{2}{7}$, the unit is divided into seven equal parts, and two of these parts are taken; in the fraction $\frac{6}{21}$ the unit is divided into twenty-one equal parts, and six of such parts are taken. Now there are three times as many parts taken in the second fraction as there are in the first fraction; but three parts in the second fraction are only equal to one part in the first fraction; therefore the six parts in the second fraction equal the two parts taken in the first fraction; therefore $\frac{2}{7} = \frac{6}{21}$.

2. Multiply the difference between $3\frac{1}{2}$ of $1\frac{1}{14} + 7\frac{1}{2}$ and $2\frac{1}{7} \div \frac{3}{5}$ of $\frac{5}{21}$ by the sum of $\frac{1}{4\frac{2}{3}}$ and $\frac{1}{5\frac{2}{7}}$.

(*a*) $3\frac{1}{2}$ of $1\frac{1}{14} + 7\frac{1}{2} = \frac{7 \times 15}{2 \times 14} + 7\frac{1}{2} = 4\frac{1}{2}$

(*b*) $2\frac{1}{7} \div \frac{3}{5}$ of $\frac{5}{21} = \frac{15 \times 3 \times 21}{7 \times 2 \times 5} = \frac{27}{2} = 13\frac{1}{2}$

difference between (*a*) and (*b*) $= 9$.

(*c*) $\frac{1}{4\frac{2}{3}} + \frac{1}{5\frac{2}{7}} = \frac{3}{14} + \frac{7}{37} = 1\frac{11}{518}$.

Difference between (*a*) and (*b*) multiplied by result of (*c*)
$= \frac{9}{1} \times 1\frac{11}{518} = \underline{10\frac{11}{518}}$. Ans.

3. Find in money the value of 2·8675 of £5 10s.; and express 3 po. 5½ yds. as the decimal of an acre.

(*a*)

£
2·8675
5·5
1 43375
14 3375
£15·77125
20
15·4258.
12
5·1d.

∴ Ans. = £15 15s. 5·1d.

(*b*) $\frac{3 \text{ po. } 5\frac{1}{2} \text{ yds.}}{1 \text{ ac.}} = \frac{3{\cdot}1\dot{8} \text{ po.}}{1 \text{ ac.}}$

$= \frac{{\cdot}079\dot{5}\dot{4} \text{ ro.}}{1 \text{ ac.}}$

$= {\cdot}0198863\frac{1}{2} \text{ ac.}$ Ans.

4. A can do a piece of work in 8 days and B in 10 days; after A has worked 3 days B joins him. In how many days will the work be finished from the time A began?

A does $\frac{1}{8}$ of the work in 1 day and $\frac{3}{8}$ in 3 days;
B ,, $\frac{1}{10}$,, ,,
∴ A and B do $\frac{1}{8} + \frac{1}{10}$ or $\frac{9}{40}$ in 1 day.

Now after A does $\frac{3}{8}$ there are $\frac{5}{8}$ to be done.
∴ $\frac{9}{40} : \frac{5}{8} :: 1$ day : Time they take to finish.

$\frac{1 \text{ day} \times 5 \times 40}{8 \times 9} = \frac{25}{9} = 2\frac{7}{9}$ days.

∴ From the time A began, the work has consumed
$3 + 2\frac{7}{9}$ days or $\underline{5\frac{7}{9} \text{ days.}}$ Ans.

FEMALES.

1. Find the value of 15 yds. 2 ft. 3 in. at £2 7s. 10d. per yd.

£	s.	d.	
2	7	10	= cost of 1 yd.
		5	
11	19	2	= ,, 5 yds.
		3	
35	17	6	= ,, 15 yds.
1	3	11	= ,, 1 ft. 6 in.
0	11	11½	= ,, 9 in.
37	13	4½	= ,, 15 yds. 2 ft. 3 in. Ans.

18 in. = ½ of 1 yd.
9 in. = ½ of 18 in.

2. What is the largest number that will divide both 475 and 589; and the smallest which will contain 18, 28, 30, and 42?

(*a*)

4	475	589	1
	456	475	
	19	114	6
		114	

G.C.M. = 10. Ans.

(*b*)

2)18, 28, 30, 42.
3) 9, 14, 15, 21,
7) 3, 14, 5, 7,
3, 2, 5, 1.

∴ L.C.M. = 2 × 3 × 7 × 3 × 2 × 5 = 1260. Ans.

3. Add $\frac{3}{8}$, $\frac{5}{6}$, and $\frac{7}{12}$; and subtract from the sum $\frac{43}{120}$.

(*a*) $(\frac{3}{8} + \frac{5}{6} + \frac{7}{12}) = \frac{48 + 45 + 70}{120} = 1\frac{43}{120}$ = sum. Ans.

(*b*) $1\frac{43}{120} - \frac{33}{120} = \frac{163 - 99}{120} = \frac{64}{120} = \underline{\frac{8}{15}}$ = diff. Ans.

4. I spend ⅓ of my money; then ¼ of what remains; and lose ⅕ of what is still left. What fraction of the whole will be left?

After spending ⅓ there remains ⅔ of whole;
,, ¼ of ⅔ there remains ⅓ of ⅔ or ¼ of whole;
,, ⅕ of ¼ there remains ⅘ of ¼ or $\underline{\frac{1}{5}}$ of whole. Ans.

Grammar.

MALES AND FEMALES.

1. *Here* Ouse, *slow winding* through a level *plain*
Of spacious *meads* with cattle *sprinkled o'er*,
Conducts the eye *along* his sinuous course
Delighted. COWPER.

Analyse the above, parsing the words in italics.

ANALYSIS.

I. *Subject* ... ... 'Ouse.'

II. *Attributive adjuncts of subject* ... 'slow winding through a level plain of spacious meads with cattle sprinkled o'er.'
'slow' *adv. of manner, mod.* the verb 'winding'; 'through a level plain' *adv. phrase, mod.* 'winding'; 'of spacious meads,' *adj., phr., attrib. to* 'plain'; 'with cattle sprinkled o'er'; *part. phr., attrib. to* 'plain.'

III. *Predicate* ... ... 'Conducts.'

IV. *Object* ... ... 'eye.'

V. *Attributive adjuncts of object* ... ... 'the,' *adj.* or *article*; 'delighted,' *part.*

VI. *Adverbial adjuncts* ... 'here,' *adv. of place.*
'along his sinuous course,' *adv., phr. of place.*

PARSING.

Here—adv. of place, mod. 'conducts.'
slow—adv. of manner, mod. 'winding.'
winding—incomplete part. of the irreg. intrans. verb *wind, wound, wound*, predic. of 'Ouse.'
plain—com. noun, neut., sing. obj., gov. by prep. 'through.'
meads—com. noun, neut., plu. obj., gov. by prep. 'of.'
sprinkled—complete part. of the reg. trans. verb *sprinkle*, predic. of 'meads.'

o'er—adv. of manner, mod. 'sprinkled.'
conducts—reg. trans. verb, indic. pres., indef., 3rd pers., sing., agr. with 'Ouse.'
along—prep., showing relation between 'conducts' and 'course.'
delighted—complete part. of reg. trans. verb *delight*, predic. of 'eye.'

2. Mention verbs ending in 'le,' like 'sprinkle.'

English verbs ending in 'le' have a frequentative meaning; as, dazzle, twinkle, prattle, puzzle, rattle, rustle, dimple.

3. Give examples of adjectives ending in 'ish' and 'en,' and explain the significance of those terminations.

Adjectives ending in 'ish' have a diminutive meaning, or a partaking of the quality of the word from which the adjective is formed; as, boyish, whitish, blackish, childish.
Adjectives ending in 'en' mean 'made of'; as, golden, wooden, brazen, waxen, woollen, wheaten.

Geography.

(*Answer either Question* 1 *or Question* 2, *not both.*)

1. Draw a map of the north-eastern counties of England (Northumberland, Durham, and Yorkshire); and describe, as fully as you can, *referring at each step to your map*, the river-basins of these counties, and the boundaries of those basins.

N.B.—Insert the lines of latitude and longitude.

In the north of England there are three river-basins which are but slightly separated, and whose slopes almost coincide in direction—the *basins of the Tees, Wear, and Tyne.* These rivers rise near each other in the neighbourhood of Cross Fell, and flow in an easterly direction. The name Wear Dale Forest is given to the watershed which separates the basins of the Tyne and the Wear, and Teesdale Forest to that which separates the basins of the Wear and the Tees. The Tees basin is separated from the basin of the Yorkshire Ouse by spurs from the Pennine and York Moors. The Tyne drains the country which occupies the angle between the Pennine Moors and the Cheviots.

2. Say what you know about Anglesea, Argyllshire, and Galway.

Draw an outline map of *one* of these counties, and insert the lines of latitude and longitude.

Anglesea is an insular county in the N.W. of Wales. Its surface is comparatively flat, and its climate is mild, but unfavourable to the growth of timber. The soil is fertile and well cultivated, but its manufactures are insignificant. The minerals are copper, lead, and silver ores, coal, marble, and granite. There are many Druidical remains. The chief towns are Beaumaris, Amlwch, and Holyhead connected with Dublin by a submarine telegraph.

Argyllshire lies in the extreme west of Scotland, and chiefly consists of peninsulas and islands. It is the second largest county in Scotland, and one of the most thinly inhabited. The surface is mountainous, and only a small part is cultivated. Cattle are reared for exportation. The chief towns are Inverary, Dunoon, Campbelltown, Oban, Bowmore (in Islay), and Tobermory (in Mull).

Galway is a maritime county in the west of Ireland. It is the second largest of Irish counties, and its coast is extremely rugged and deeply indented. The surface is extremely mountainous in the west, Connemara being one of the wildest districts in Ireland. The east is flat and fertile, but interspersed with bog. The climate is humid and mild. Oats and potatoes are the chief crops. Cattle are extensively reared, and the coast fisheries are valuable. The Irish language is general in many districts of the county. The chief towns are Galway, Tuam, Ballinasloe, and Loughrea.

3. Trace minutely the journey of a traveller, landing in Nova Scotia, and going by land to British Columbia. Describe, in the order in which he would come to them, the physical features of the country, and the chief towns on his route.

Landing at Halifax, whose fine harbour is the admiration of the world, the traveller may proceed across Nova Scotia through a generally undulating but not mountainous country into New Brunswick, whose surface is varied, its northern part forming a table-land, having upon it numerous ranges of hills and studded with lakes. Its centre part rises gradually from the St. Lawrence towards the interior for a considerable distance. Generally, the natural features of this province are picturesque rather than bold and startling. The capital is Fredericton, a pretty town; but the chief place is St. John, one of the most picturesque and flourishing cities of the North American Provinces. Leaving New Brunswick, the traveller enters the Province of Quebec (formerly Lower or East Canada), which is characterised by picturesque scenery, consisting of boundless forests, magnificent rivers and lakes, extensive prairies, and bold, rocky heights. Quebec, the capital, is very strongly fortified, stands on the north bank of the River St. Lawrence; and Montreal, on an island at the confluence of the St. Lawrence and Ottawa, has a thriving trade. The tubular bridge, which carries the Grand Trunk Railway over the St. Lawrence, is one and a quarter miles long. He is now in the Province of Ontario, the surface of which is gently undulating, and diversified with lakes and rivers, the lakes being numerous and magnificent. Proceeding along the route of the Canada Pacific Railway, he traverses the marshy district on the north of the great lakes, and reaches the great prairie land of Manitoba, with its busy capital Winnipeg. Continuing his now wild and inhospitable journey through the prairie region, he follows the valley of the Saskatchewan, and crossing the Rocky Mountains by the Vermilion Pass, which lies between the upper portions of the Southern Saskatchewan and the Kutanie, a tributary of the Columbia, he enters the District of Columbia. The eastern half is very mountainous; but the greatest diversity of soil is met with in this province, lake, mountain, forest, marsh, and prairie frequently alternating.

History.

1. Who were the earliest traders with this island? To what part of it, and for what articles did they come?

The Phœnicians were the first to introduce this island to the notice of the civilized world. Several centuries before the Christian era they fetched tin from the Scilly Isles, which Herodotus, the earliest writer who mentions our country, calls Cassiterides (tin-islands).

2. What resistance was offered by our native tribes to the Roman invaders? Give some account of Julius Agricola, his policy and exploits.

In 54 B.C. Julius Cæsar was opposed by Cassivellaunus, who led the united British tribes against the Romans. In A.D. 43 the Britons of the centre, east, and west, headed by the south Welsh (Silures) maintained a fierce resistance under Caradoc (Caractacus), against the Roman advance. In A.D. 47 Ostorius Scapula, after a strong resistance by the Iceni and Brigantes, captured Caractacus. In A.D. 61 Suetonius Paulinus, on his march against Mona (Anglesea), had a tremendous battle with the Druids, and during his absence from London, Boadicea raised a revolt, and massacred many thousands of Roman settlers.
The great epoch in the history of the Roman conquest of Britain is the command of Julius Agricola, from A.D 78 to 85. It was his fleet that sailed round Britain, and thus first proved it to be an island. He not only subdued, but did his best to civilize. As to the subduing of it, he put down all resistance, defeated the Caledonians in a great battle at the Grampian Hills, and built a chain of forts from the Firth of Forth to the Firth of Clyde.

3. Write down names and dates of our sovereigns from Edmund Ironside to Edward the Confessor, and explain how the Saxon dynasty came to an end.

		A.D.		A.D.
Edmund II. (Ironside)	reigned from	1016	to	1017.
Canute	,, ,,	1017	,,	1036.
Harold I.	,, ,,	1036	,,	1039.
Hardicanute	,, ,,	1039	,,	1041.
Edward (Confessor)	,, ,,	1041	,,	1066.

The Saxon dynasty came to an end on the field of Senlac, by the death of Harold II., who was defeated and slain by William of Normandy, 1066.

Composition.

Write from memory the substance of the passage read to you once by the Inspector.

'The intense chill of the north wind in the desert of Central Asia,' says a traveller, 'cannot be imagined by any one who has not wintered there. The cattle, though abundantly supplied with warm clothing, suffer much at night from the wind striking their legs and penetrating to their belly and haunches. The breath clings in icicles to the pillow and bed-clothes within the tent. Towels hung up to dry stiffen into ice, and water freezes

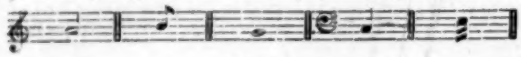
hard, in a close room, within three feet of a charcoal fire. All the rest of my head and face, when I travelled, was snugly packed in fox's fur, but it was very difficult to preserve the nose from being frost-bitten. With fingers of a violet colour, and stiff as sealing-wax, I had to form an arch under which the heat of the breath collected and thawed the nose.'

Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write above each of the following notes its value-name (semibreve, &c.); and below each its pitch-name (C, D, E, &c.):—

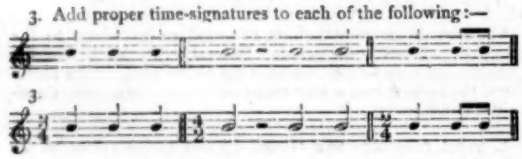


1.

2. Write down the minor thirds contained between the notes of the scale of C :—

2.

3. Add proper time-signatures to each of the following:—



3.

TONIC SOL-FA NOTATION.

1. Write a six-pulse tone, using three-pulse measures.

1. | l :— :— | — :— :— ||

2. Write down the minor thirds contained between the notes of the common scale.

2. *Ray* and *fah*; *me* and *soh*; *lah* and *doh*^{1}; *te* and *ray*^{1}.

3. Write the following an octave higher :—

s m l t_1 f m r l_1 t_1 d

3. s^1 m^1 l^1 t f^1 m^1 r^1 l t d^1

SECOND YEAR.

Pupil Teachers at end of Second Year.

Three hours and a half allowed for this Paper.

MALES.

Euclid.

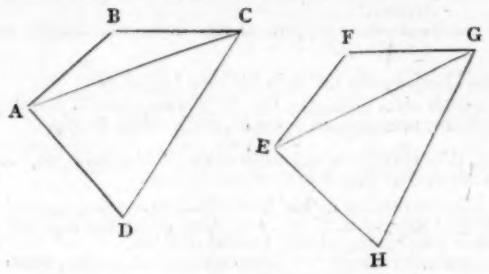
All generally understood abbreviations for *words* may be used.

1. If two quadrilaterals have three sides of the one equal to three sides of the other, and likewise the angles contained by the equal sides equal in each, the figures shall be equal in every respect.

Let ABCD, EFGH be two quadrilaterals having the three sides AB, BC, CD respectively equal to the three, EF, FG, GH, and likewise $\angle$s ABC, BCD respectively equal to the $\angle$s EFG, FGH; then the figures ABCD, EFGH shall be equal in every respect—that is, the remaining side AD=EH, the $\angle$ ADC=$\angle$ EHG, and $\angle$ BAD=$\angle$ FEH.

Join AC, EG; then by Prop. 4, Bk. I., the $\triangle$ ABC=$\triangle$ EFG in every respect, and $\therefore$ $\angle$ BCD=$\angle$ FGE, but the whole $\angle$ BCD = whole $\angle$ FGH (Hyp.) and $\therefore$ the remainder ACD=remainder EGH, and the base AC=the base EG.

Again, because AC=EG, and CD=GH (Hyp.) and the included $\angle$ ACD=$\angle$ EGH, $\therefore$ by Prop. 4, Bk. I., the $\triangle$s ACD, EGH are equal in every respect, and $\therefore$ AD=EH and the $\angle$ ADC=EHG, and the $\angle$ CAD=$\angle$ GEH.



To each of the $\angle$s CAD, GEH add respectively the equal angles BAC, FEG and the whole $\angle$ BAD=the whole $\angle$ FEH.

Therefore the figures are equal in every respect, for the remaining side AD=EH, the $\angle$ ADC=$\angle$ EHG, and the $\angle$ BAD = $\angle$ FEH.

2. To draw a straight line perpendicular to a given straight line of unlimited length, from a given point without it.

Prop. 12, Bk. I.

3. To make a triangle of which the sides shall be equal to three given straight lines, but any two whatever of these must be greater than the third.

Prop. 22, Bk. I.

Arithmetic.

FEMALES.

1. A can dig a garden in 5 days, B in 6 days, and C in 7 days. In what time will all three working together finish it? Find also the time in which A and B together, A and C together, and B and C together, could respectively finish it.

In 1 day A does $\frac{1}{5}$; B, $\frac{1}{6}$; and C, $\frac{1}{7}$.

$\therefore$ A, B, and C do together $\frac{1}{5}+\frac{1}{6}+\frac{1}{7}$ or $\frac{42+35+30}{210}$

$=\frac{107}{210}$ in 1 day.

And $\therefore$ they will do the whole in $\frac{210}{107}$ or $1\frac{103}{107}$ day. Ans.

A+B do $\frac{1}{5}+\frac{1}{6}$ or $\frac{11}{30}$ in 1 day; the whole in $2\frac{8}{11}$ days. Ans.

B+C ,, $\frac{1}{6}+\frac{1}{7}$ or $\frac{13}{42}$,, ,, ,, $3\frac{3}{13}$ days. Ans.

A+C ,, $\frac{1}{5}+\frac{1}{7}$ or $\frac{12}{35}$,, ,, ,, $2\frac{11}{12}$ days. Ans.

2. Reduce $\frac{5}{8}$ of half-a-crown to the fraction of £1.

$$\frac{\frac{5}{8}\text{ of }30\text{d.}}{240\text{d.}}=\frac{30\times 8}{240\times 9}=\frac{1}{9}.\quad\text{Ans.}$$

3. After spending $\frac{3}{8}$ of my money, I find that $\frac{4}{7}$ of the remainder is 1s. 9d.; what had I at first?

After spending $\frac{3}{8}$ there remains $\frac{5}{8}$.

$\frac{4}{7}$ of $\frac{5}{8}=21$d. or 21d. $=\frac{1}{2}\frac{3}{8}$ of the whole.

$\therefore$ the whole $=21\text{d.}\div\frac{1}{2}\frac{3}{8}=\frac{21\times 35}{12}=\frac{245}{4}$d.

$=61\frac{1}{4}$d. $=$ 5s. $1\frac{1}{4}$d. Ans.

4. Reduce $\frac{1}{7}$ to six decimal places.

$$\frac{1}{7}=\frac{1\cdot000000}{7}=\underline{\cdot142857\ldots\ldots}\quad\text{Ans.}$$

Grammar.

MALES AND FEMALES.

1. *She*, good *cateress*,
Means her provision *only* to the *good*,
That live according to her sober laws,
And holy *dictate* of *spare* temperance.

COMUS.

Analyse the above, parsing the words in italics.

2. What Latin prefixes and terminations do you see in it?

3. Paraphrase the passage. ('She' refers to 'Nature.')

ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Completion.	Extension.	Connective.
1.						
She, good cateress, means her provision only to the good,	Principal	she, good cateress,	means	her provision (*dir. obj.*) to the good (*indir obj.*)	only (degree)	
2.						
That live according to her sober laws, and holy dictate of spare temperance.	Subord. adjective to 'the good' (in 1)	that	live		according to, etc.,.... temperance (*manner*)	that

PARSING.

She—demonstr., 3rd pers., pron., fem., referring to 'Nature,' sing., nom., subj. of 'means.'

cateress—com. noun, fem., sing., nom., in apposition with 'she.'

means—irreg. trans. verb, *mean, meant, meant*, indic., pres., indef., 3rd pers , sing., agr. with 'she.'

only—adv. of degree, mod. 'means.'

good—adj., used as a noun, collective, plur., mas. or fem., obj., gov. by prep. 'to.'

that—simple rel. pron., referring to 'the good,' 3rd pers., mas. or fem., plur., nom., subj. of 'live.'

live—reg. intrans. verb, indic., pres., indef., 3rd pers., plur., agr. with 'that.'

according to—prep. phrase, relating to 'live' and 'laws,' and gov. the latter in obj. case.

dictate—abstr. noun, neut., sing., obj., gov. 'according to.'

spare—adj., pos. deg., qual. 'temperance.'

2. The Latin prefixes in the above are: 'pro' in 'provision,' and 'ac' (ad) in 'according.'

The affixes are 'ion' in 'provision,' 'ate' in 'dictate,' and 'ance' in 'temperance.'

3. Nature, like a thrifty provider, so disposes her blessings that none are expected to have the full enjoyment of them but those who are guided by the rules of temperance and sobriety.

4. How is the prefix 'in' (meaning 'not') modified in composition? Give instances.

'In' (meaning 'not') is modified into *i, il, im, ir;* as, *i*gnoble, *i*gnore; *il*literate, *il*legal; *im*maculate, *im*pure; *ir*rational, *ir*regular. 'In' often interchanges with 'un,' as *un*certain, *in*justice, *un*just.

Geography.

Answer either Q. 2 or Q. 3, not both.

1. Draw a map of Spain and Portugal; and describe, as fully as you can, *referring to your map for illustration*, the water-partings and river-basins of that peninsula.

N.B.—Insert the lines of latitude and longitude.

The peninsula of Spain and Portugal is crossed by long mountain-ranges parallel to each other, which run from west to east, and which support between them the table-lands that are also the valleys of rivers flowing from east to west. Thus the Cantabrian Mts. and the Sierra Guadarama enclose the valley of the Douro; the Sierra Guadarama and the Sierra Toledo shut in the high and rocky basin of the Tagus. Again, the Sierra Toledo and the Sierra Morena form the rim of the Guadiana basin; while the Sierra Morena and the Sierra Nevada bound the valley of the beautiful Guadalquivir. The triangular valley of the Ebro is enclosed by the Pyrenees on the north, and by the steep sides of the eastern end of the central table-land.

2. Between what degrees of latitude and longitude does Russia in Europe lie? Explain exactly what is meant by saying that any place is in a certain *degree* of latitude and longitude. What are the most northerly, and the most southerly, points of that country?

European Russia lies between lats. 40° 20′ and 70° N., and between long. 17° 50′ and 67° E.

The degree of latitude and longitude gives us the exact locality of a place on the surface of the earth. The degree of latitude tells us how far the place is north or south of the Equator, and the degree of longitude how far the place lies east or west of our First Meridian, which passes through Greenwich Observatory. The degree is divided into 60 minutes, and the minute into 60 seconds.

The most northerly point of the mainland is east of Tana Fiord, in Lapland, and the most southerly is Cape Apsheron, the eastern extremity of the Caucasus, on the Caspian Sea.

3. Say what you know about the cultivation of rice, indigo, tea, and cotton in British India, and distinguish the different parts of that country which are suitable for each of these articles.

Rice, which forms the staple food of the inhabitants, grows on the bank of the lower Ganges, and all around the sea-coast. Its cultivation requires an immense quantity of moisture, and it grows best in fields which are, or can be, inundated. It is generally sown while the waters cover the land. The plants are also grown from cuttings, which are steeped in water first and then placed in the soil or mud brought down by the flooded river. When six inches high these are planted into rows one foot apart.

Indigo is chiefly produced in Bengal, in the delta of the Ganges. This plant is a native of India, from which country it takes its name. To obtain the dye, the plants are cut down when they begin to flower, and are steeped in water until they slightly ferment. When the fermentation ceases, the water is drawn off and violently agitated. It is then allowed to settle, and a thick sediment forms at the bottom, which sediment drained and dried is the indigo of commerce. The seeds are sown in spring at the rate of about a dozen pounds per acre. The plants grow rapidly, blossom in about three months, are cropped, and allowed to grow again. They are cropped a second, a third, and sometimes even a fourth time, when the process given above is gone through to procure the colouring matter.

Tea is grown in the moist, warm valleys of the Himalaya mountains, and particularly in Assam, where the plant was found growing wild. This plant is a hardy evergreen, from three to six feet in height. The plant is propagated by seeds, on light, strong ground, and requires an abundance of light and air. The plants are sown five or six in a hole in rows four or five feet asunder. The first crop is gathered when the plant is three years old.

Cotton is indigenous to India, and grows chiefly in the uplands of N. and W. Coimbatore and Mysore are famous for their crops, as also Guzerat and Scinde. Another district is the *Doab*, or country between the Jumna and Ganges; and it is also grown to a large extent in the valleys of the Godavery and Kistna. A large quantity of the cotton produce of India is consumed in the native manufactures; but there is still an immense quantity for export. During the last twenty years the quantity shipped to England has more than doubled.

Arithmetic.

MALES.

Two hours and a half allowed.

1. If the 4d. loaf weighs 2¼ lb. when wheat is 45s. per qr., how much ought the 6d. loaf weigh when wheat is 54s. per qr.?

$$\left.\begin{matrix}4\text{d.} : 6\text{d.} \\ 54\text{s.} : 45\text{s.}\end{matrix}\right\} :: 2\tfrac{1}{4}\text{ lb.} : ?$$

$$\frac{36\text{ oz.} \times 6 \times 45}{4 \times 54} = 45\text{ oz.} = \underline{2\text{ lb. }13\text{ oz.}}\quad \text{Ans.}$$

2. What principal will amount to £1310 8s. 7½d. in 2 years at 4½ per cent. per annum, compound interest?

(*a*) Compound interest on £100 for 2 yrs. at 4½ p.c. = £9·2025
Amount of " " = 109·2025

(*b*) £1310 8s. 7½d. = £1310·43

(*c*) ∴ £109·2025 : £1310·43 :: £100 : Principal.

$$\frac{£100 \times 1310{\cdot}43}{109{\cdot}2025} = \frac{£131043}{109{\cdot}2025} = \underline{£1200}.\quad \text{Ans.}$$

3. A tradesman buys £520 worth of goods, and sells ⅔ of them at a gain of 15 per cent., and the rest at a loss of 5 per cent.; what is his average gain per cent. and his total gain on the goods?

$\frac{3}{4}$ of £520 = £390

	£	s.
Selling price of goods worth £390 = £390 × $1\frac{1}{10}$ =	448	5
" " £130 = 130 × $\frac{99}{100}$ =	123	5
Price of goods sold =	572	0
Prime cost of " =	520	0
Total gain on £520 =	52	0

∴ £520 : £100 :: £52 : £10 gain p.c. Ans.

4. A man invests money in the 3 per cents. at 97½, and on their rising to 98½ he sells out and gains £24; how much money did he invest? (Omit brokerage.)

£98½ − £97½ = £1, the gain on every £97½.

∴ £1 : £24 :: £97½ : Money invested.

$£97\frac{1}{2} \times \frac{24}{1} = \frac{799 \times 24 \times 4}{8 \times 3} = £3116.$ Ans.

History.

MALES AND FEMALES.

1. What were the crusades? Name any English princes who took part in them, and mention benefits they are said to have produced.

In 1095 A.D. a council of the Church held at Clermont resolved that an attempt should be made to rescue the city of Jerusalem from the hands of Mahommedan infidels, called Saracens, who held possession of it. A religious enthusiast, Peter the Hermit, journeyed through Europe, and called on the nobles, knights, and kings to deliver the sepulchre of Christ from the infidels. In 1096 the first expedition was formed, and which, from the *cross* sewn upon the dress of those who joined it, has been called a *crusade*.

The English princes who took part in them were, Robert, eldest son of William I., Richard I., and Edward, afterwards Edward I.

The benefits accruing from them were the check given to the tide of Mahommedan conquest in the direction of Europe, making people of one country acquainted with those of another, and introducing into Europe the arts, literature, civilisation, and commerce of the East.

2. What sovereign reigned between Henry III. and Edward II.? Show briefly the characteristics of the three reigns.

Edward I. reigned between Henry III. and Edward II. The reign of Henry II. is characterised by the confirmation of Magna Charta, and by the summoning of the first regular parliament; that of Edward I. by his conquest of Wales, his wise and patriotic management of affairs in England, and by his obstinate attempts to conquer Scotland, which he invaded and overran; and that of Edward II., by the timidity and effeminacy of the king, who allowed himself to be governed by favourites, and was unable to carry out the designs of his father, by the assertion of Scottish independence under Bruce, and by the revolt of the English against a monarch who disgusted them, and who was finally murdered in Berkeley Castle, 1327.

3. Who was the consort of Richard III.? Sketch her career, and explain the importance attached at this time to the hand of Elizabeth of York.

The consort of Richard III. was Anne Neville, younger daughter of the Earl of Warwick, styled the "king-maker." She was the wife of Prince Edward, son of Henry VI. and Margaret of Anjou; but she was left a widow by the cold-blooded murder of her husband at Tewkesbury, 1471, by the Dukes of Gloucester and Clarence. On the Duke of Gloucester's proposing to marry the young widow, Clarence concealed her in London, but Gloucester found her and carried her off to the Sanctuary of St. Martin's. On application to the king and Council he was permitted to marry her, and the estates of her father were shared between her husband and Clarence, who had married her sister Isabella. When Gloucester became king she was crowned as his queen in Westminster. On her death Richard had some designs of marrying Elizabeth, who represented the House of York, she being considered to have the best claim on the throne of any then living.

Teaching.

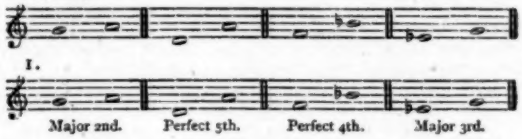
How do you deal with hard words which occur in the course of a reading lesson; and how can you make sure that they are properly spelled and understood by your class?

The hard words occurring in the course of the lesson should be written or printed on the black-board and divided into syllables. To make sure that they are properly spelled and understood by the class these words should be pronounced in syllables by the children, explained by the teacher as to meaning (and derivation, if the class is an advanced one). Turning the board, let the words be dictated and written on slates to test whether the children have mastered their difficulties; or let them be copied on slates and brought up at next day's lesson. It is a good plan to note the hard words that occur from time to time, and give them out as a revising lesson.

Music.

A quarter of an hour allowed for this paper.

(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

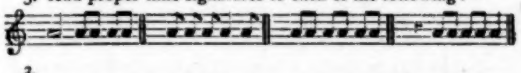
1. Write below each of the following intervals its name (minor third, &c.):—

1.

Major 2nd. Perfect 5th. Perfect 4th. Major 3rd.

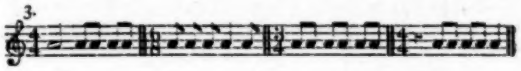
2. Write the scale of B flat, placing the necessary flats before the notes to be flattened.

2.

3. Add proper time-signatures to each of the following:—



3.



TONIC SOL-FA NOTATION.

1. What is the interval (major third, &c.) (*a*) between *soh* and *lah*; (*b*) between *ray* and *lah*; (*c*) between *doh* and *fah*; (*d*) between *doh* and *me*?

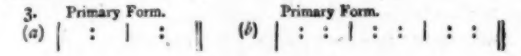
1. (*a*) Major 2nd; (*b*) Perfect 5th; (*c*) Perfect 4th; (*d*) Major 3rd.

2. What is the mental effect (*a*) of *te*; (*b*) of *lah*?

2. (*a*) Piercing; (*b*) Mournful.

3. Write (*a*) the pulse signs for a four-pulse measure; (*b*) nine-pulse measure.

3. Primary Form. Primary Form.



(*a*) (*b*)

THIRD YEAR.

Pupil Teachers at end of Third Year, *if apprenticed on or after 1st May,* 1878; **and Pupil Teachers at end of Fourth Year,** *if apprenticed before that date.*

Three hours and a half allowed.

Euclid.

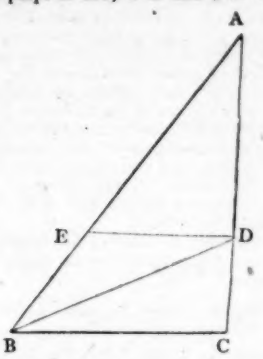
[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including Question 1, *if you can.*

MALES.

1. AB is the hypothenuse of a right-angled triangle ABC. BD is drawn bisecting the angle B and meeting AC at D, and DE perpendicular to AC meets AB at E. Prove that the triangle EDB is isosceles.

Since ED is perp. to AC, it is also ∥ to BC (I. 28) and ∴



∠EDB = ∠DBC (I. 29), but ∠DBC = ∠EBD, ∴ ∠EDB = ∠EBD and ∴ △EBD is isosceles (I. 6). Q. E. D.

2. If a straight line falling on two other straight lines make the alternate angles equal to each other; these two straight lines shall be parallel.

Prop. 27, Bk. I.

3. Equal triangles upon equal bases in the same straight line, and towards the same parts, are between the same parallels.

Prop. 39, Bk. I.

Algebra.

Answer two Questions.

1. A starts for a walk at the rate of 4 miles an hour, and after 15 minutes B follows him at the rate of $4\frac{3}{4}$ miles an hour; when and where will he overtake A?

(*a*) Let x = number of miles gone by both

then $\frac{x}{4}$ = time A takes in hours.

and $\frac{x}{4\frac{3}{4}}$ = ,, B ,, ,, ,,

$$\therefore \quad \frac{x}{4} - \frac{x}{4\frac{3}{4}} = \tfrac{1}{4} \text{ hour.}$$

$$\frac{x}{4} - \frac{4x}{19} = \tfrac{1}{4}$$

$$19x - 16x = 19$$

$$3x = 19$$

$$x = 6\tfrac{1}{3} \text{ miles.} \quad \text{Ans.}$$

$$\frac{6\frac{1}{3}}{4\frac{3}{4}} = \tfrac{4}{3} = 1 \text{ hour 20 min.} \quad \text{Ans.}$$

2. Square $1 - 2x + 3x^2 - 2x^3 + x^4$, and resolve $(4x - 7y)^2 - 9y^2$ into factors.

(*a*)

$$(1 - 2x + 3x^2 - 2x^3 + x^4)^2 = 1 + 2(-2x + 3x^2 - 2x^3 + x^4) + 4x^2 - 4x$$
$$(3x^2 - 2x^3 + x^4) + 9x^4 + 6x^2(-2x^3 + x^4)$$
$$+ 4x^6 - 4x^5 (x^4) + x^8$$
$$= 1 - 4x + 6x^2 - 4x^3 + 2x^4 + 4x^2 - 12x^3 +$$
$$8x^4 - 4x^5 + 9x^4 - 12x^5 + 6x^6 + 4x^6 -$$
$$4x^7 + x^8$$
$$= 1 - 4x + 10x^2 - 16x^3 + 19x^4 - 16x^5 + 10x^6 - 4x^7 + x^8. \quad \text{Ans.}$$

NOTE.—*The square of a polynomial consists of the square of each term, together with twice the product of each term by the sum of all the terms which follow it.*

(*b*) $(4x - 7y)^2 - 9y^2 = \{(4x - 7y) + 3y\}\{(4x - 7y) - 3y\}$

$$= (4x - 4y)(4x - 10y)$$
$$= 8(x - y)(2x - 5y). \quad \text{Ans.}$$

3. Solve the equations:—

(1) $\frac{3}{5}(x - 5) - \frac{3}{11}(x - 13\frac{1}{3}) = 5 - \frac{1}{5}(7 - x)$.

(2) $\frac{17}{6x + 17} - \frac{10}{3x - 10} = \frac{1}{1 - 2x}$

(1) $\frac{3}{5}(x - 5) - \frac{3}{11}(x - 13\frac{1}{3}) = 5 - \frac{1}{5}(7 - x)$

$$110(x - 5) - 45\left(\frac{3x - 40}{3}\right) = 825 - 33(7 - x)$$

$$110x - 550 - 45x + 600 = 825 - 231 + 33x$$

$$110x - 45x - 33x = 825 - 231 - 600 + 550$$

$$32x = 544$$

$$x = \underline{17}. \quad \text{Ans.}$$

(2) $$\frac{17}{6x + 17} - \frac{10}{3x - 10} = \frac{1}{1 - 2x}$$

$$51x - 170 - 60x - 170 = \frac{18x^2 - 9x - 170}{1 - 2x}$$

$$-9x - 340 = \frac{18x^2 - 9x - 170}{1 - 2x}$$

$$18x^2 + 680x - 9x - 340 = 18x^2 - 9x - 170$$

$$680x = 170$$

$$x = \underline{\tfrac{1}{4}}. \quad \text{Ans.}$$

Mensuration.

Show by an example that if a square and a rectangle have equal perimeters, the area of the square exceeds the area of the rectangle by the area of a square whose side is half the difference of the sides of the rectangle.

Let the side of the square = 4, then perimeter = 16.

Then the rectangle may be 6×2 to equal perimeter of square.

∴ If the above theorem be correct the area of the square (which is $4^2 = 16$), must be greater than the area of the rectangle (which is $6 \times 2 = 12$) by the area of a square whose side is half the difference of the sides of the rectangle (which is $\sqrt{(\frac{1}{4} \text{ of } 6 - 2)}$ or $\underline{2}$).

$(4)^2 - (6 \times 2) = 4$, area of a square.

Now the side of this square must be $\sqrt{4}$ or 2, which is equal to the diff. of the sides of rect. Q. E. D.

FEMALES.

Arithmetic.

1. In a school of 200 children there are four classes, of which the first contains ·24, the second ·36, and the third ·18 of the whole; of how many does the fourth class consist?

$·24 + ·36 + ·18 = ·78$ or $\frac{78}{100}$.

∴ the fourth class consists of $\frac{22}{100}$ of 200 or $\underline{44}$. Ans.

2. In a school of 100, the ages of 4 children average 13·5, of 16 others 12·375, of 34 others 11 years, the average of the whole is 10·575 years; find the average age of the remaining children.

The ages of	4 =	(collectively)	13·5 × 4 =	54
,,	16 =	,,	12·375 × 16 =	198
,,	34 =	,,	11 × 34 =	374
The ages of	54 =	,,	=	626
,,	100 =	,,	10·575 × 100 =	1057·5
∴ ,,	46 =	,,		431·5

Average age of the 46 = $\frac{431·5}{46} = \underline{9·38}\ldots$ Ans.

3. If a team can plough 4·6 acres a day, how long will they take to plough 63·25?

4·6 ac. : 63·25 ac. :: 1 day : ?

$$\frac{1 \text{ da.} \times 63·25}{4·6} = \underline{13·75} \text{ days.} \quad \text{Ans.}$$

4. If 5 horses consume 7 bus. 2 pks. of oats in 11 days, how much will 22 horses consume in 10 days?

5 horses : 22 horses
11 days : 10 days
} :: $7\frac{1}{2}$ bush. : ?

$$\tfrac{15}{2} \text{ bush.} \times \tfrac{22}{5} \times \tfrac{10}{11} = \frac{15 \times 22 \times 10}{2 \times 5 \times 11} = \underline{30} \text{ bush.} \quad \text{Ans.}$$

Grammar.

MALES AND FEMALES.

1.

Morning fair
Came forth, with *pilgrim steps* in amice *gray*,
Who with her radiant finger *still'd* the *roar*
Of thunder, *chased* the clouds, and *laid* the winds
And grisly *spectres which* the fiend had raised.

MILTON.

Analyse the foregoing, parsing the words in italics.

2. Paraphrase the passage. ('Amice' means a pilgrim's robe.)

ANALYSIS.

Sentence.	Kind.	Subj.	Predicate	Completion.	Extension.	Connective.
(1) Morning fair came forth with pilgrim steps in amice gray	Principal	Morning fair	came		forth (*place*), with pilgrim steps in amice gray (*manner*)	
(2) Who with her radiant finger still'd the roar of thunder	Principal.	who	stilled	the roar of thunder	with her radiant finger (*instrument*)	who = and she
(3) (who) chased the clouds	Principal.	(who)	chased	the clouds		(who = and she)
(4) and (who) laid the winds and grisly spectres	Principal.	(who)	laid	the winds and grisly spectres		and
(5) which the fiend had raised	Adj. to (4)	the fiend	had raised	which		which

PARSING.

Fair—adj. qual. 'morning.'
pilgrim—noun used as an adj., qual. 'steps.'
steps—com. noun, neut., plur., obj., gov. by 'with.'
gray—adj., qual. 'amice.'
who—simple rel., referring to 'morning' (personified), 3rd pers., sing., fem., nom., subj. of 'still'd.'
still'd—reg. trans. verb, indic., past indef., 3rd pers., sing., agr. with 'who.'
roar—abstr. noun, neut., sing., obj. gov. by 'still.'
chased—reg. trans. verb, indic., past, indef., 3rd pers., sing., agr. with ('who').
laid—irreg. trans. verb, *lay*, *laid*, *laid*, indic., past, indef., 3rd pers., sing., agr. with ('who').
spectres—com. noun, conveying either an idea of mas. or fem., plur., obj., gov. by 'laid.'
which—simpl. rel., referring to both 'winds' and 'spectres,' mas., fem., or neut., obj. gov., by 'had raised.'

2. The fearful storms which raged during the night, and which seemed from their violence to have been raised by supernatural agency, quieted down at the dawn of day, and the skies gradually assumed a more cheerful aspect.

3. Point out the prefix in each of the following words :—Spend, enormous, symmetry, accede, pellucid, ignoble, co-agulate, suppress, combustion.

The prefixes are :—*s* for *dis* in 'spend'; *e=ex* in 'enormous'; *sym=syn* in 'symmetry'; *ac=ad* in 'accede'; *pel=per* in 'pellucid'; *i=in* in 'ignoble'; *co=con* in co-agulate; *sup=sub* in 'suppress,' and *com=con* in 'combustion.'

Geography.

1. Give 'Notes of a Lesson' on 'The Native Tribes of Africa,' distinguishing the different parts of the country where each of them is found, and describing, as for children, the features, appearance, and habits of each.

NATIVE TRIBES OF AFRICA.

NEGROES.—(1) *Foolahs*. (2) *Mandingoes*. (3) *Jaloofs*—spread over Senegambia, western Soudan, and Upper Guinea. (1) Most deserving of attention; superior in intelligence and civilisation; have a noble bearing; fine, regular features; comparatively light complexion resembling the rich brown of the Spaniards; lead a nomadic life, and have some manufactures and commerce. (2) Are also a civilized race, though inferior to (1); of a deep black colour; woolly hair; thick lips, broad flat nose, and tall powerful frame; their leading men read and write Arabic; engaged in manufactures and commerce. (3) Live in the deltas of the Gambia and Senegal; are mild, hospitable, and trustworthy, but are physically of a low type; live by hunting; Soudan, the true home of the Negro, where he is by no means the miserable-looking and degenerate creature which he seems to be when subjected to the bondage and inhuman treatment of the white man. In Guinea the natives are generally in a low state of civilisation—pagans—slavery and polygamy prevail—and human sacrifices are practised by several tribes.

HOTTENTOTS.—Confined to the S.W. angle of Africa, extending from Cape Negro to Cape Agulhas, and as far inland as the Kalahari desert; are a nomadic people—never cultivate the soil—nor rear a domestic animal—get subsistence from roots, beans, and the flesh of game—form one of the most degraded sections of humanity, and their features are hideous.

KAFFIRS.—Occupy the rest of South Africa, living N. and E. of the Hottentots, and in some places extend from sea to sea. On the western side of the Continent, extending from the Equator to Cape Negro, and on the eastern from Cape Colony to the borders of the Somali country. They are described as a fine athletic race, frequently as handsome as Europeans; till the ground and engage in agriculture.

NOTE.—*Map of Africa, or sketch on blackboard; explanations to be given as lesson proceeds; all proper names to be written, spelt, and pronounced.*

2. Daw a full map of Turkey in Asia. Insert the lines of latitude and longitude.

3. Name, in order, the great rivers of Asia, and briefly describe their courses.

3. RIVERS OF ASIA.

FLOWING INTO THE PACIFIC OCEAN.

River	Rises in	Flows	Through	Falls into
Meinam.	Borders of China.	S.	Siam.	Gulf of Siam
Mekong.	"	S.	Annam.	Chinese Sea.
Yang-tse-Kiang.	Tibet.	E.	Central China	Yellow Sea.
Hoangho	"	E.	Northern China.	" "
Amoor, or Saghalien.	North of Mongolia.	E.	S.E. of Siberia, and north of Manchooria.	Gulf of Tartary.

FLOWING INTO ARCTIC OCEAN.

Lena.	W. of Lake Baikal.	N.E. and N.	Eastern Siberia	Arctic Ocean
Yenisei.	Mongolia.	N.	Central "	Bay of Yenisei.
Obi.	Altai Mounts.	N.W. and W.	Western "	Gulf of Obi.

FLOWING INTO THE INDIAN OCEAN,

Euphrates—Tigris.	Armenian Mounts.	W. and S.E. S.E.	East of Turkey.	Pers'an Gulf
Indus.	Tibet.	N.W. and S.	Tibet and India.	Arabian Sea.
Ganges.	Himalayas	S.E.	India.	Bay of Bengal.
Brahmaputra	Tibet.	E. and N.	Tibet and India	Bay of Bengal.
Irrawady.	Borders of Tibet.	S.	Burmah and Pegu	Gulf of Martaban.
Saluen.	Borders of Tibet.	S.	Burmah and Pegu	Gulf of Martaban.

SECOND PAPER.

Two hours and a half allowed.

Arithmetic.

MALES.

1. A grocer by selling tea at 2s. 9d. per lb., gains 12 per cent.; what did the tea cost him per cwt.?

1 cwt. at 2s. 9d. per lb. = $2\frac{3}{4}$s. × 112 = 308s.
∴ 112 : 100 :: 308s. : Cost per cwt.

$$\frac{308\text{s.} \times 100}{112} = 275\text{s.} = \underline{£13\ 15\text{s.}}\ \text{Ans.}$$

2. Define discount. Find the (true) discount on a bill of £401 16s. due 219 days hence at 4 per cent. per annum.

Discount is an allowance or deduction according to the rate of interest for money advanced before it is due. Bankers calculate interest on the sum drawn for in a bill from the time of discounting it till it becomes due. This discount is greater than the *true discount* by the interest of the latter for the time that the bill has still ro run.

Interest of £100 for 219 days at 4 p. c. $= \frac{4 \times 219}{375} = £2\frac{3}{5}$
Amount " " " $= 102\frac{3}{5}$.
∴ $102\frac{3}{5} : 2\frac{3}{5}$ :: £$401\frac{1}{4}$: True discount;

$$£401\tfrac{1}{4} \times \frac{2\frac{3}{5}}{102\frac{3}{5}} = \frac{2009 \times 12}{5 \times 512} = £\frac{24108}{2560} = \underline{£9\ 8\text{s.}\ 4\tfrac{1}{2}\text{d.}}\ \text{Ans.}$$

3. How much stock must I sell out of the 3 per cents. at 99¼ to purchase £1584 stock in 4 per cent. railway stock at 126¾, brokerage being charged in each case?

$$99 : 126\tfrac{3}{4} :: £1584 : \text{Stock to be sold.}$$

$$£1584 \times \frac{126\tfrac{3}{4}}{99} = \frac{1584 \times 1015}{792} = \underline{£2030}. \quad \text{Ans.}$$

4. A number of men at a tavern spent as many farthings each as there were men, and the sum spent was £1 10s. 1d. How many were there?

No. of men × no. of farthings = £1 10s. 1d.
" " " = 1444 farthings.
but no. of men = no. of farthings.
∴ $\sqrt{1444}$ = no. of men = 38. Ans.

History.

MALES AND FEMALES.

1. When did the English begin to found colonies? Mention instances and enumerate the benefits of the measure.

The foundation of the Colonial Empire of Great Britain must be dated from the time of Henry VII., when John and Sebastian Cabot discovered Newfoundland and Labrador, but no colony was attempted to be formed until the time of Queen Elizabeth. Sir Humphrey Gilbert led a company to Newfoundland in 1583 and took possession of the country, but no settlement was made. In 1584, Sir Walter Raleigh discovered Virginia, and next year he took out 108 colonists whom he settled at the mouth of the Roanoke. This was the first actual occupation of territory by English in America, but like several others it proved unsuccessful, and one really permanent was not effected till 1607 when James-town, on the river James, was founded. On Dec. 1st, 1620, the Pilgrim Fathers landed at New Plymouth and established the New England colony.

Originally the colonies formed an asylum to political and religious refugees, but at the present time one of the greatest advantages is that they furnish a home for thousands of poor who find it hard to live in their own country. Others are valuable as stations to shelter our fleet; others valuable as trading stations for collecting produce from the surrounding countries, or for distributing English goods; and some act as half-way houses to supply ships with water, provisions, or coal.

2. Sketch the character of Charles II. and describe the chief events of his reign.

Charles II. had few qualities which merited the love bestowed upon him by his subjects at his restoration. He had talents, easy good-temper, and the manners of an accomplished gentleman, but neither heart nor principles. So far as he had any religion, he was secretly a Roman Catholic; as a ruler, his inclination was towards a despotic monarchy; but he did not risk his crown by grasping at more power. He was resolved, as he used to say, 'not to go on his travels again,' and his main object in life was to be amused and to avoid trouble.

The chief events of his reign were the passing of the Corporation Act (1661); of the Act of Uniformity (1662); of the Conventicle Act (1664); and of the Five-Mile Act (1665); the Great Plague (1665); Dutch War and the Great Fire of London (1666); Treaty of Breda (1667); Triple Alliance (1668); Test Act (1673); Titus Oates' Plot (1678); Habeas Corpus Act, Bothwell Bridge, and Meal Tub Plot (1679); and Rye House Plot (1683).

3. Give dates of the queens who have reigned in England, with the names and nationality of their husbands.

QUEEN.			HUSBAND.
Mary I.	reigned from	1553 to 1558	Philip of Spain.
Elizabeth	"	1558 " 1603	None.
Mary II.	"	1689 " 1694	William of Orange (Holland).
Anne	"	1702 " 1714	George of Denmark.
Victoria	"	1837 "	Albert of Saxe Coburg and Gotha (Germany).

Teaching.

Write notes of a lesson on either (1) A lake, or (2) (for infants) The furniture of the schoolroom.

Notes of a lesson on a 'LAKE.'

Show sketch or picture of pond, or lake, and maps with lakes clearly shown.

DEFINITION.—A lake is water surrounded by land—water generally fresh—surplus water carried off by river (*show that a pond is a miniature lake and its stream like a river*).

WHERE FOUND.—Lakes most numerous in hilly countries; because there the valleys are most numerous; valleys collect the waters from the mountains.

EXAMPLES.—American lakes so large as to be called 'fresh-water seas,' Lake Superior the largest lake in the world; largest in Europe, Lake Ladoga in Russia; Cumberland lakes in England, small, but very beautiful, that part called 'Lake District'; Scotland, being mountainous, has more lakes than England, some of them surrounded with lofty mountains or with beautiful woods, reaching down to the water's edge; Loch Lomond, 'Queen of Scottish Lakes'; in Ireland, Lakes of Killarney are very beautiful, lying among the mountains of Cork.

USES.—Great resorts of pleasure-seekers—some of great use in commerce. (*Examples.*)

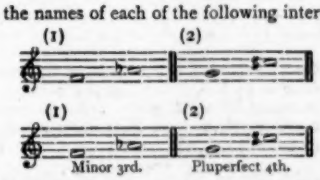
NOTE.—Lakes found having streams flowing into them but none flowing out; such usually salt (Caspian, Aral, and Dead Seas, really lakes).

Music.

A quarter of an hour allowed for this paper.

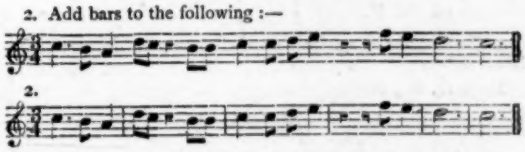
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write the names of each of the following intervals:—



Transpose the above one octave lower in the Bass clef.

2. Add bars to the following:—



3. Explain the following terms:—(*a*) *Da Capo*; (*b*) *Rallentando*; (*c*) *Legato*.

3. (*a*) Repeat from the beginning; (*b*) Slackening of the speed; (*c*) Smoothly, in a gliding manner.

TONIC SOL-FA NOTATION.

1. What is the interval (*a*) between *me* and *fah*; (*b*) between *ray* and *soh*; (*c*) between *me* and *te*? What is the name (*d*) for *fah sharp*; (*e*) for *te flat*?

1. (*a*) Minor 2nd; (*b*) Perfect 4th; (*c*) Perfect 5th; (*d*) *fe*; (*e*) *ta*.

2. What are the five kinds of measure commonly used?

2. Two-pulse; three-pulse; four-pulse; six-pulse; nine-pulse.

3. Explain the following terms:—(*a*) *Da Capo*; (*b*) *Rallentando*; (*c*) *Legato*.

3. (*a*) Repeat from the beginning; (*b*) Slackening of the speed; (*c*) Smoothly, in a gliding manner.

FOURTH YEAR.

Pupil Teachers at end of Fourth Year, *if apprenticed on, or after,* 1st *May,* 1878; **and Pupil Teachers at end of Fifth Year,** *if apprenticed before that date.*

FIRST PAPER.

Three hours and a half allowed.

Euclid.

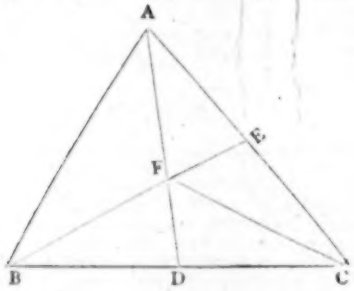
MALES.

[All generally understood abbreviations for *words* may be used.]

Answer two Questions, including No. 1, *if you can.*

1. Find a point equidistant from the angles of a given triangle.

Let ABC be the given △, bisect AC in E, and BC in D, draw EF perp. to AC, and DF perp. to BC, and let EF, DF meet in F, F is the point required.



Because AE = EC, and EF is common to the two ∠s AEF, CEF, and ∠ AEF = ∠ CEF. ∴ (I. 4) AF = FC.

For a similar reason BF = FC, and ∴ the three straight lines AF, FC, FB are equal, and ∴ F is equally distant from the angles of the given △. Q. E. F.

2. If a straight line be bisected, and produced to any point; the rectangle contained by the whole line thus produced, and the part of it produced, together with the square on half the line bisected, is equal to the square on the straight line which is made up of the half and the part produced.

Prop. 10, Bk. II.

3. To describe a square that shall be equal to a given rectilineal figure.

Prop. 14, Bk. II.

Algebra.

Answer two Questions, including No 1., *if you can.*

1. How would you explain to a class the rule of signs in multiplication?

$(+a\times+b=+ab. \quad -a\times+b=-ab. \quad +a\times-b=-ab. \quad -a\times-b=+ab.)$

Because $+a\times+b$ means that $+a$ is to be added to itself as many times as there are units in b, then it equals $+ab$.

Because $-a\times+b$ means that $-a$ has to be repeated as often as there are units in $b=-a-a-a$, etc., b times, or $=-ab$.

Or, suppose that $b=3$, then $-a\times3$ indicates that $-a$ is to be *repeated three* times, that is, we have $-a-a-a$ or $-3a$ as the result. Thus

$$-a\times+b=-ab.$$

In the cases $+a\times-b=-b$; and $-a\times-b=+ab$ the multiplier is a *negative quantity*, and thus the common arithmetical notion of multiplication is not applicable; we must therefore give by definition a meaning to the term in this case. Now we observe that when the multiplier is positive, the sign of the multiplicand is preserved in the product, thus we are led to adopt the following convenient guide: *When the multiplier is negative, perform the multiplication as if the multiplier were positive and change the sign of the product.* Hence we conclude immediately that

$$+a\times-b=-ab \text{ and } -a\times-b=+ab.$$

2. Find the cube root of $:-729x^3+2673x^2y+3267xy^2+1331y^3$

$729x^3+2673x^2y+3267xy^2+1331y^3$ $(9x+11y.$ Ans.

$(9x)^3=729x^3$

divisor $(9x)^2\times3+(3\times9x+11y)11y=2673x^2y+3267xy^2+1331y^2$

$\therefore 243x^3+297xy+121y^2\times11y=2673x^2y+3267xy^2+1331y^3$

3. Solve the equations:—

$$\left.\begin{aligned}(1)\ \frac{2x}{3}+\frac{4y}{5}&=64\\ \frac{5x}{6}+\frac{9y}{10}&=77\end{aligned}\right\}$$

$$(2)\ \frac{48}{x+3}=\frac{165}{x+10}-5.$$

3. (1) $\frac{2x}{3}+\frac{4y}{5}=64$ or $50x+60y=4800$

$\frac{5x}{6}+\frac{9y}{10}=77$ or $50x+54y=4620$

$6y=180$

$y=\underline{30}$. Ans.

Hence $x=\underline{60}$. Ans.

$$(2)\ \frac{48}{x+3}=\frac{165}{x+10}-5.$$

$48x+480=165x+495-5x^2-65x-150$

$5x^2-52x=-135$

$x^2-\frac{52}{5}x=-\frac{135}{5}$

$x^2-\frac{52}{5}x+(\frac{26}{5})^2=\frac{676-675}{25}=\frac{1}{25}$

$x-\frac{26}{5}=\pm\frac{1}{5}$

$x=\frac{26}{5}\pm\frac{1}{5}=\underline{5}$ or $\underline{5\frac{2}{5}}$. Ans.

Mensuration.

An area in the form of an equilateral triangle is paved at 9d. per sq. ft., and fenced at 5s. per ft.; show that the cost of fencing is to the cost of paving as $80\sqrt{3}$ is to three times the number of feet in a side.

Let x = no. of feet in side.

Then $3x$ = perimeter; and 5s. $\times\ 3x=15x$ = cost of fencing.

$\frac{x^2\sqrt{3}}{4}$ = area in sq. ft.; and $\frac{3}{4}$s. $\times\ \frac{x^2\sqrt{3}}{4}=\frac{3x^2\sqrt{3}}{16}$ cost of pav.

∴ Cost of fencing : cost of paving :: $15x:\frac{3x^2\sqrt{3}}{10}$

or $240x:3x^2\sqrt{3}$

or $80:x\sqrt{3}$

and ∴ $80\sqrt{3}:3x$

Q. E. D.

Arithmetic.

FEMALES.

1. Find the amount of £250 lent on October 27th, 1883, and repaid March 21st, 1884, at 5 per cent.

No. of days from Oct. 27th to March 21st
$= 4 + 30 + 31 + 31 + 29 + 21 = 146.$

$\therefore$ Interest $= \frac{£250 \times 146 \times 5}{365 \times 100} = £5$

and $\therefore$ the amount $= \underline{£255}$. Ans.

2. Find the cost price of a thing which if sold at 7 per cent. profit would realise 5s. more than if it were sold at 17 per cent. loss.

5s. $= \frac{107 - 83}{100}$ of cost price

$= \frac{24}{100}$ " "

$\therefore$ Cost price $= \frac{5s. \times 100}{24} = \underline{£1\ 0s.\ 10d.}$ Ans.

3. Divide £70 among 3 persons, so that their shares shall be to each other as 1, 2, and 3.

Total shares $= 1 + 2 + 3 = 6.$

	£	s.	d.	
$\therefore$ 1st gets $\frac{1}{6}$ of £70, or	11	13	4.	Ans.
2nd " $\frac{2}{6}$ " or	23	6	8.	Ans.
3rd " $\frac{3}{6}$ " or	35	0	0.	Ans.

4. In what time will £1240 amount to £1336 12s. 4d. at 4½ per cent. simple interest?

Interest = £1336 12s. 4d. − £1240 = £96 12s. 4d.

£	s.		£	s.	d.
$\therefore$ 4	5	:	96	12	4
20			20		
85			1932		
12			12		
1020d.		:	23188d.		:: 1 yr. : Time.
£1240		:	£100		

$\frac{1 \text{ yr.} \times 23188 \times 100}{1020 \times 1240} = \frac{19}{16} = 1\frac{3}{16}$ yr. Ans.

Grammar.

MALES AND FEMALES.

1. It is well known to the learned that the ancient laws of Attica rendered the exportation of figs criminal; that being supposed a species of fruit so excellent in Attica that the Athenians deemed it too delicious for the palate of any foreigners; and in this ridiculous prohibition they were so much in earnest that informers were thence called 'sycophants' among them.

HUME.

Analyse each of the sentences in the above which begins with the word 'that.'

ANALYSIS.

Sentence.	Kind.	Subject.	Predicate.	Completion.	Extension.	Connective.
(1) That the ancient laws of Attica rendered the exportation of figs criminal; that being supposed a species of fruit so excellent	Subord. noun.	the ancient laws of Attica	rendered	the exportation of figs that being considered a species of fruit so excellent (*dir. obj.*) criminal (*indir. obj.* or *complement*)		that
(2) that the Athenians deemed it too delicious for the palate of any foreigners	Subord. adv.	the Athenians	deemed	it (*dir. obj.*) too delicious for the palate of any foreigners (*indir. obj.* or *complement*		that
(3) that informers were thence called 'sycophants' among them.	Subord. adv.	informers	were called	sycophants (*indir. obj.* or *complement*)	among them (*place*)	that

2. Parse each word in the following:—

'That being supposed a species of fruit so excellent.'

PARSING.

That—demonstr. adj. pron., referring to 'fruit,' neut., sing., nom. absolute along with 'being.'
being—irreg. intrans. verb, *am, was, been*, incomplete part., forming with 'that' nom. absolute.
supposed—reg. trans. verb, complete part, predic. of 'that.'
a—adj. or indef. art., referring to 'species.'
species—abstr. noun, neut., sing., nom. after 'being supposed,' meaning the same as 'that.'
of—prep., relating 'species' to 'fruit.'
fruit—com. noun, neut., sing., obj., gov. by 'of.'
so—adv. of degree, mod. 'excellent.'
excellent—predic. adj., qual. 'fruit.'

3. Write out a list of words compounded or derived from the Latin verbs, 'amo,' 'duco,' 'fero,' 'audio.'

From 'amo' come; amorous, amiable, amatory.
" 'duco' " ductile, induce, re-, pro-, se-, conduce, reduction.
" 'fero' " ferry, infer, circumference, reference, defer.
" 'audio' " audit, audience, audible, auditor.

Geography.

Answer two Questions.

(*Answer Questions* 1 *and* 2, *and No.* 3, *if you have time.*)

1. How should you try to give to town children, who have never seen the sea, a clear idea of the nature of the tides? (Illustrate by diagram, and give examples of high or rapid tides.)

INTRODUCTION.—Tell the children that though they may never have seen the sea, yet there is a rise and fall of its waters every 12 hours or so, enabling ships to go up rivers, and float down again, which, without 'tides,' would be impossible. (*Direct attention to the proportions of the land and water on the Map of the World, and give a few remarks on gravitation.*)

HOW TIDES ARE CAUSED.—They are produced by the attraction of the sun and moon, but principally by the influence of the moon. The moon attracts all things on earth; pulls them towards it; and water being fluid, changes its shape as it is pulled, and rises up towards the moon in a large heap. As the earth is spinning round all the time, the water is carried on and will not rise quite in the same shape that it would if it were at rest, but gets spread out into a broad flat wave. This tidal-wave goes travelling along over the surface of the sea following the moon, and always two or three hours behind it; and as it comes to the various places along the coast, it forms the high tide there. The moon rises a similar heap of water on the opposite side of the world, at the same time, so that there are always two tidal-waves going round at once, each half a day apart. The sun also attracts the water, though, from being so far off, much less than the moon does. When the two come in line, and pull together—that is at new and full moon—the tides are highest, and called *spring* tides; when they are at right angles to one another—that is at the moon's quarters—the tides are lowest, and called *neap* tides.

EXAMPLES.—The foregoing is the general principle of the tides, but it is very much interfered with by the form of the coast, the depth of the sea, the friction of the water on itself and on the shore, the action of the wind, the ocean currents, and many other things. The original height of the tidal-wave—the heap raised by the moon—is from 3 to 4 feet, which is the rise of the tide in the Pacific; but where there is a bay or inlet, with high steep walls, the water will force its way in, and rise much higher. In the Bristol Channel the tides are forced up as high as 30, and even 50 feet; and in the Bay of Fundy, to 70, 80, and even 100. On the coast of Jutland, in the German Ocean, owing to the tide-wave from the north meeting that from the south round Great Britain, there is little or no variation, but perpetual high water.

2. Draw a full map of the United States, and describe, as fully as you can, referring to your map, the water-partings and river-basins of that country.

(Insert the lines of latitude and longitude.)

The Alleghanies or Appalachian Chain extend from the Gulf of St. Lawrence to the State of Alabama, and form the water-parting between the rivers which flow into the Atlantic, and the two great basins of the Mississippi and the St. Lawrence.

The Rocky Mountains consist of two, and in some places of three, parallel chains; the two principal ranges being:—1. The Pacific Range, extending from Alaska to the peninsula of California, and forms the water-parting between the Pacific on the west and the Youcon and Rio Colorado on the east. 2. The Rocky Mountain Chain forms a wavy line from the mouth of the Mackenzie in the Arctic Ocean to near Lake Nicaragua in Central America, and separates the basins of the Columbia and the Rio Colorado on the west from those of the Missouri, Arkansas, and the Rio del Norte on the east.

All the rivers of this part of America belong to three great oceanic basins—viz., those inclining to the Atlantic, to the Gulf of Mexico, and to the Pacific. Besides these we have a continental basin, similar to those of the continents of the Old World—viz., the Great Basin in Utah and Nevada, which contains the Great Salt Lake, and many others which are salt, and have no outlet.

The great basin of the Mississippi is bounded on the east by the Alleghanies, and on the west by the Rocky Mountains.

3. Describe in order the different countries of South America, and say what you know about their history.

COUNTRIES OF SOUTH AMERICA.

1. *U. S. of Colombia*, formerly New Granada, in the N. W. It has been subject to several revolutionary changes and civil wars. *Ecuador* was founded in 1831 when the Republic of Colombia was divided into three sections. The Republic of *Venezuela* was established at the same time as Ecuador. *Guiana* is divided into three parts—British, Dutch, and French. British Guiana came into our possession in 1814. The whole originally belonged to the Dutch. *Brazil*, discovered in 1500, was colonised by the Portuguese. It became independent in 1822, when the government was vested in a hereditary emperor, a senate, and a chamber of representatives. *La Plata* or *Argentine Republic*, settled by Spain, 1553, has been virtually independent since 1806, but the authority of Spain was not openly set aside until 1810. *Paraguay* has been subject to many changes since Spain colonised it in 1535. During a war with Brazil in 1870, a full half of the male population was slain. *Uruguay*, formerly a province of Brazil, declared its independence in 1825, and became a free state in 1828, though it is virtually under the protection of Brazil. *Patagonia* is inhabited by a nomadic race of great stature. *Chili* (Spanish *Chilé*) was invaded by the Spaniards after the conquest of Peru. The colonists threw off the Spanish yoke in 1818, when the country became an independent republic. *Bolivia*, formerly a part of Peru, became independent in 1825, when it took the name of Bolivia from its champion Bolivar. *Peru* was first visited by the Spaniards in 1530. After its conquest by Pizarro, it continued subject to Spain till 1821, when it became independent.

SECOND PAPER.

Two hours and a half allowed.

Arithmetic.

MALES.

1. If a woman, by selling 5 herrings for 7d., gains 12 per cent., what per cent. would she gain by selling them 6 for 9d.?

5 cost 7d. ∴ 1 cost $\frac{7}{5}$d.
6 sell for 9d. ∴ 1 sells for $\frac{3}{2}$d.
∴ $\frac{7}{5}:\frac{3}{2}::112:$ Hundredths of price.
$\frac{112\times3\times5}{2\times7}=120$ hundredths.
∴ the gain per cent. is 20. Ans.

2. A man invested money in the Three per Cents. at 101$\frac{1}{8}$, and on their falling to 100$\frac{1}{4}$ he sold out, and thereby lost £24. How much stock did he hold, and how much did he pay for it? (Omit brokerage.)

Loss on 101$\frac{1}{8}$ = (101$\frac{1}{8}$ − 100$\frac{1}{4}$) = £$\frac{3}{4}$
(*a*) ∴ £$\frac{3}{4}$: £24 :: 101$\frac{1}{8}$: Cost of stock.
$101\frac{1}{8}\times24\div\frac{3}{4}=\frac{811\times24\times4}{8\times3}=£3244$. Ans.
(*b*) 101$\frac{1}{8}$: 100 :: 3244 : Stock
$\frac{3244\times100\times8}{811}=£3200$ of stock. Ans.

3. If a banker, by deducting bankers' discount instead of true discount from a bill due eight months hence at 4$\frac{1}{2}$ per cent. per annum gains 9s., what is the amount of the bill?

Interest on £100 for 8 mos. at 4$\frac{1}{2}$ p. c. = £3.
∴ £3 or 60s. : 9s. :: £100 : True discount.
$\frac{£100\times9}{60}=£15$, true discount on the sum.
Now true discount on £103 for 8 mos., etc. = £3
∴ £3 : £15 :: £103 : Sum required.
$\frac{£103\times15}{3}=£515$. Ans.

Note.—The difference between the true and the usual discount is the interest on the true discount.

4. A and B, whose capitals are as 3 : 4, joined in business, and at the end of 4 months they withdrew $\frac{2}{3}$ and $\frac{3}{4}$ respectively of their capitals; how should a gain of £624 be divided amongst them at the end of 12 months?

$(3\times4)+(\frac{2}{3}\times8)=26{\cdot}4$ per month for A.
$(4\times4)+(\frac{3}{4}\times8)=36{\cdot}$ „ „ B.
$62{\cdot}4$ „ for A and B.
∴ $\frac{26{\cdot}4}{62{\cdot}4}$ of £624 = £264, A's share. Ans.
624 − 264 = £360, B's „ Ans.

History.

MALES AND FEMALES.

1. What was the real extent of English success in Ireland under Henry II.? Give names and position of the Irish provinces at that period.

Though Prince John was established by Henry II. as Lord of Ireland after the nominal submission of the Irish kings, nothing but the feuds and weakness of the Irish tribes enabled the English adventurers to hold the districts of Drogheda, Dublin, Wexford, Waterford, and Cork, which formed what was known as the 'English Pale.' Had the Irish driven the invaders into the sea, or the English succeeded in the complete conquest of Ireland, much of its after history might have been avoided. Unhappily Ireland, while powerless to effect its deliverance, was strong enough to hold its assailants at bay. The country was broken into two halves, whose conflict has never ceased. The country was at that time divided into five principal kingdoms—Meath in the middle, Ulster in the north, Leinster in the south-east, Munster in the south-west, and Connaught in the west.

2. What improvements were introduced by Richard III. in reference to the statutes of Parliament, protection of commerce, and transmission of intelligence?

Richard III. met an appeal of the citizens of London by convoking Parliament, which had been all but discontinued under Edward IV., and by introducing sweeping measures of reform. In the one session of his brief reign he declared the practice of extorting money by 'benevolence' illegal; and the energy of the government was seen by a series of enactments striving to protect the growing interests of English commerce. The king's interest in literature showed itself in the provision that no statutes should act as a hindrance 'to any artificer, or merchant stranger of what nation or country he be for bringing unto this realm, or selling by retail or otherwise, of any manner of books written or imprinted.'

3. Account for the greater content of the English people at the present time compared with one hundred years ago.

The greater contentment of the English people may be accounted for from the following facts:—food, clothing, and luxuries are cheaper, taxation is very much lighter, education is now general; newspapers and books of every kind are more easily obtained; conveyance of passengers and letters brought nearly to perfection, Parliament (with some truth) represents the people; houses and sanitary arrangements improved, the criminal and poor-laws immensely advanced. The only questions that prevent full contentment seem to be those relating to land, liquor, labour, and government. Mr. Gladstone's proposed Franchise Bill promises to remove some of the wrongs of British voters.

Teaching.

Say how you would explain to scholars the difference between trades and professions.

THE DIFFERENCE BETWEEN TRADES AND PROFESSIONS.

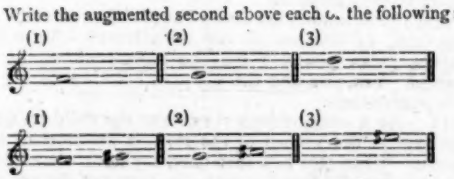
In defining the difference between a trade and a profession, it may be stated that the former is a handicraft occupation, and the latter an occupation depending chiefly on study and learning. The professions are acquired by long and laborious application at schools and universities, under professors specially eminent for their knowledge of certain branches of learning; while a trade may be acquired in a workshop or some technical school under practical masters who have gained their skill by experience in a special line of business. In the case of a trade a certificate of competency is very valuable and sometimes necessary; but to follow out a profession a diploma of a high order is absolutely required. The different kinds of trades are almost innumerable, and fall under the general term *skilled labour*. But professions are comparatively few on account of the time, labour, and money needed for mastering them; they are almost all comprised under these heads, the *medical*, *legal*, and *clerical professions*, which are sometimes called briefly the *learned professions*.

Music.

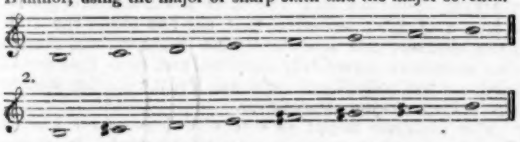
A quarter of an hour allowed for this paper.

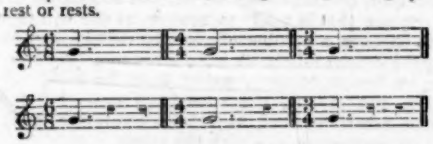
(N.B.—Pupil Teachers may answer the questions in either the Staff Notation or the Tonic Sol-fa, but *not both*. The questions in the Tonic Sol-fa Notation will be found at the end.)

1. Write the augmented second above each of the following:—



2. Write before the notes the sharps essential to the scale of B minor, using the major or sharp sixth and the major seventh.



3. Complete each of the following bars by adding the necessary rest or rests.

TONIC SOL-FA NOTATION.

1. What is the interval (*a*) between *fah* and *se*; (*b*) between *doh* and *re*; (*c*) between *doh*' and *fe*?

1. (*a*) Augmented 2nd; (*b*) Augmented 2nd; (*c*) Diminished 5th.

2. In the minor mode (*a*) what is the essential sixth, and (*b*) what is the essential seventh?

2. (*a*) *Fah*; (*b*) *se*.

3. Re-write the following, doubling the value of every note and rest:—

|m . :s .f |n .r : ‖

3. |m : |s :- .f |n :r | : ‖

—o—

Article 106 (*b*)

Merit Grant in Infant Schools.

BY MRS. MORTIMER,

Lecturer on Kinder-garten at the Home and Colonial Training College, London.

LESSON—THE PIGEON.

CLASS—CHILDREN UNDER SIX.

Apparatus:—Picture and stuffed specimen of common pigeon.

I. *Description.*—The stuffed specimen should be shown to the children, and they should be asked to name it.

Have any of you seen a pigeon alive? There is a little boy who says he has some pigeons at home. I expect he will be able to tell us a great deal about them.

What would you say about the size of the pigeon? It is not very large. Can you tell me the names of some birds that are smaller than the pigeon? Yes, the swallow, the sparrow, the robin, etc. Now, tell me some that are larger than the pigeon? The hen, the stork, the swan, etc.

Now, tell me the name of the different parts of the pigeon as I point to them. The head, the beak, the eyes, the neck, the wings, the body, the tail, the legs, the toes, the claws.

A picture of several birds should be shown, and then the teacher should call attention to the curved, or arched beak of the pigeon. For what does the pigeon use its beak? What is another name for the beak? What would you say of the wings? They are rather long and very strong.

The teacher pointing to another kind of pigeon should say, Both these birds are pigeons. Can you tell me any difference in them? Yes, the tail of that one stands up. Do you know anything that it looks like? It is something like a fan. (If the teacher were here to show the children a fan made of feathers, they would see the resemblance.) Yes, and because this pigeon's tail is like a fan, we call these pigeons *Fan-tail* pigeons. Now, tell me how many toes it has? Three in front, and one behind. What has it on the end of its toes? Claws. What can you say about them? They are curved.

Now, look at the neck of this bird. Is it like this pigeon's? No, it has a large lump on it. Yes, this is also a pigeon, and because the bottom part of the neck is large, we call these birds *Pouter* pigeons.

II. *Habits.*—There was one little boy who told me that he kept pigeons at home. I wonder if he will tell us where he keeps them? In a house in the garden; my big brother made it. That was very good of him. Do you ever see pigeon-houses in any other place? Sometimes they are put on the roofs of houses, and sometimes they are built against the side of a house. Of what are these houses made? Of wood. What are they like? Yes, like a large doll's-house, with a great many little round holes. For what are these holes made? For the pigeons to go into their house whenever they want to. Why do they not have one large hole? Because there are a number of small houses in the one large one, and the pigeon likes to have his own house and door. What do the pigeons do in these houses? They make their nests. Of what do they make them? When they have made them what do they do? Lay their eggs in them. Do you know how many eggs the pigeon lays? Yes, two pretty little white ones. See, here is one. Is it anything like the hen's egg? Yes, only it is very much smaller.

What does the pigeon do after she has laid the eggs? She sits on them to keep them warm, and after a time, when you go to look at the nest, instead of seeing eggs, what do you think you see? Yes, two very little pigeons, with hardly any feathers on. What do the old birds do for these young ones? They get food for them, and keep them very warm until all their feathers come, and they are quite strong. Then they teach them to fly.

What does the pigeon eat? Worms, and different kinds of seeds, oats, wheat, barley. Before the old pigeons give the young ones these seeds, they make them very soft. Do you know why that is? Yes, they are not strong enough to eat the hard seeds. It is just what your mother did when you were very little. She used to make the bread soft for you to eat, but now you can eat it without your mother boiling it.

There are a great many different kinds of pigeons. I have already told you about two. Which were they? The fan-tail pigeon. Why do you give it that name? The pouter pigeon. Why is it called the pouter pigeon? Then there is a very funny pigeon that keeps on turning over when it is flying in the air? I daresay if you saw it you would think it was going to fall down. This pigeon is called the *Tumbler*.

There is another kind of pigeon that I must tell you about, for it is very useful indeed. It is used to carry letters from one place to another a long way off.

Shall I tell you how they do this? The letter is written on very thin paper, and fastened under the bird's wing so as not to hurt its wing. The pigeon then flies into the air, and, after flying round, it begins to fly straight to the right place. Do you not think this is very clever? This kind of pigeon is called the *Carrier* pigeon.

There are several other kinds of pigeons, but these I must tell you about another day.

III. *Summary.*—This should consist of very simple sentences, and should be repeated by the children after the teacher, or a few very simple words should be printed on the blackboard.

The pigeon has a strong beak. It has strong wings. It has short legs. It lives on seeds and worms. There are many kinds of pigeons.

LESSON—FLOWERS.

CLASS—CHILDREN OVER SIX.

Apparatus: Specimens and pictures of flowers.

I. Now, children, we are going to talk about flowers. Why do you like them? Because they are pretty. Yes, and for some other reason? Because of their sweet smell. Now let us see how many names of flowers you can tell me. As each flower is mentioned the children should be asked to spell the name, and the teacher should write it on the blackboard. Of course, the teacher must not expect the children to spell every name, but by carefully separating the syllables, the majority of names will be spelt. Rose, wall-flower, daisy, primrose, crocus, violet, pink, geranium, fuschia, lily, stock, poppy, pansy, sweet-pea, marigold, buttercup, fox-glove, balsam, hollyhock, cowslips, nasturtium, sunflower, mignonette, tulip, daffodil, sweet william, London pride, dahlia, convolvulus, polyanthus, honeysuckle, chrysanthemum. Now read all these from the board as I point to them.

II. What time of the year do we see most flowers? In the summer-time. When do we see very few? In the winter. Yes, the flowers will not grow in the garden then. Do you know where they are then grown? Indoors. Yes, and sometimes houses are built on purpose for flowers, and fires are kept alight all the cold weather; if you were to go into such houses you would see a great many beautiful flowers. What do we call that part of the year when the flowers begin to come again in the garden? The spring. Now I want you to tell me the names of the flowers we see in the spring. See, we will put the figure 1 against the names of the spring flowers.

We walk into the garden and see some little snowdrops. What colour are they? White. And what is the colour of the crocus? Yellow. Yes, but sometimes it is blue, white, and striped. And the daffodils? etc.

What do we call the part of the year that follows spring? The summer. What kind of weather do we then have? And what does this very warm weather do? It makes the flowers grow. Yes, it makes all kinds of flowers grow. The garden is then full of flowers of all kinds of shapes and colours.

The children should now be asked to name the summer flowers, and the teacher should mark the figure 2 against them. It is more than likely that others will be mentioned. Which of all these flowers do you like the best? The rose. Why? Because it is so very beautiful, and smells so sweet and nice. Are all roses alike? Oh, no; there are a great many different kinds. Tell me some of the different kinds. Red, white, yellow, pink, and a very pretty one, with a kind of moss growing all round it. What is it called? The moss rose. Now look at these tulips. (Picture to be shown, if no specimens are obtainable), and tell me the different colours. A few other flowers might be picked out and treated in a similar manner, and the variety of shapes called attention to.

Now, when the summer has gone what kind of weather do we have? It begins to get cold, especially in the evenings, and the evenings seem to begin sooner. Yes, that is right; the evenings do begin sooner, and the weather is colder. What do we call this part of the year? Winter. No, it is not winter yet; we call this part of the year autumn. When does the autumn come? After the summer and before the winter. What kind of weather do we have? What flowers do we have in the autumn? Yes, many of the summer flowers will be seen. Do you know what will kill them? Yes, the cold, frosty nights. Then we have the asters, dahlias and chrysanthemums. The last one is a very long word for you, but I hope you will try to remember it.

After the autumn what do we have? The winter. And what kind of weather do we then have? Very cold weather. Can you tell me the names of any winter flowers? Yes, you see the chrysanthemums during the early winter-time.

III. As a recapitulatory exercise the children might then repeat the names of the flowers growing in each season. When this has been carefully done the children will have become familiar with the names of the ordinary flowers, and will be able to associate the flowers with their respective seasons. The teacher will feel after giving a lesson of this description, that she has made the children observe, and take an interest in the various objects that nature so bountifully supplies, and also that she is leading them to look out for the different varieties as each succeeding season approaches.

The children might now receive lessons on special flowers, according to the season of the year. In giving a lesson on a special flower the teacher should be careful to select one that is really in season, as she will then be able to procure a number of good specimens, *e.g.*, in the spring the crocus might be enlarged upon. Its size, the flower, its beauty, locality, growth from the bulb.

Again, the crocus, the snowdrop, and the daffodil might be taken together, and their description, etc., obtained by comparing one with the other.

In summer the rose, with its varieties in scent and colour, would make a suitable lesson.

Again, the geranium and fuschia might be taken together—the difference of stem, soft and hard; difference of leaf, round and pointed; and of flower, etc., obtained by comparison.

In autumn the beautiful and many-coloured chrysanthemums could be used for such a lesson, while in winter very interesting lessons could be given on the evergreens—the holly, the mistletoe, etc.

Again, a very useful and interesting lesson could be given by dividing the flowers into the groups, 'wild' and 'garden,' and the children taught where to look for the pretty wild flowers. Town children might have pointed out to them that some of their garden flowers are found growing wild in the country.

Another lesson would be formed by dividing the flowers into groups—beautiful flowers with scent, and beautiful flowers without scent. It might be pointed out to the children that most of the spring and autumn flowers have little or no scent.

LESSON—THE SILKWORM.

CLASS—CHILDREN OVER SIX.

Apparatus:—A silkworm, a chrysalis, a cocoon, a large drawing of silkworm.

I. *Description.*—Have you ever seen anything like this silkworm? Yes; a caterpillar, a worm. It is something like a worm, but much more like a caterpillar. Who has seen a caterpillar? Where have you seen one? Well, the silkworm is very much like one. What would you say about its shape? It is long and round. Do you know anything that is very much the same shape? Yes, a piece of pencil. What has this worm on its body? A number of legs. Let us count how many legs it has. All of you say. The silkworm has sixteen legs. How many legs have you? How many more legs than you has the silkworm? It also has a great many eyes. Seven on each side of the head. Now tell me then how many eyes it has.

II. *Habits and Food.*—The children should be asked if they know anything about silkworms. Some children like to keep them. Do you like to keep them? Why do you like to keep them? Because it is so nice to watch them. The silkworm changes several times. First of all it is to be seen flying about, and then we call it a moth. Do you know what a moth is? Where have you seen moths? Tell me an insect very much like a moth? Well, this moth has a short thick body covered with hairs. Tell me the name of another insect covered with hairs? The bee. The wings are white with darkish marks across them. They like to find a particular kind of tree, called the mulberry-tree. On the leaves of this tree the moth lays a number of tiny grey eggs. Do you know why she lays them on the leaves of the mulberry-tree? Well, listen, and I will tell you. The moth does not eat these leaves, but she knows that the tiny eggs will, in a few days, turn into little worms. These worms are very fond of the mulberry leaf, and they begin to eat very quickly, and eat all day long. What do you think this does? Yes, it makes the little worms grow very fast, and they keep on eating until they get quite big. They are then full grown and leave off eating, and begin to make something that is of great use to us. Do you know what this is? Yes, they begin to spin the silk. If you keep silkworms you will notice they wind this silk round and round their bodies, so that, when they have finished spinning, they are inside the silk. What does the silk look like when the silkworm has finished spinning? A little yellow ball. Of what shape? Something like an egg. What name do you give to this shape? We say it is of an oval shape. What colour is the silk? Where is the silkworm? Now you must learn the name of this oval piece of silk. It is called a '*cocoon.*' If you were to open the cocoon you would not find the caterpillar, for it has changed into a strange-looking thing. We say it has changed into a chrysalis. Is not that a long word? but if you look at it on the blackboard I do not think you will forget it. See, it is made up of three syllables, chrys-a-lis.

The cocoon or silk ball is really the home of the chrysalis. Well, after a short time the chrysalis also changes, and you will see a moth come out of the cocoon. To get out, it has to make a hole right through the silk, and then the silk is not of much use. What did I tell you the moth does? It flies to the mulberry-tree, and lays its eggs on the leaves. Yes; it does not fly about very much, Now, can you tell me the different changes the silkworm passes through? Yes; first it is an egg, then a silkworm, and then a chrysalis. And what after? A moth. That is quite right. How many different changes? Four.

III. *Uses.*—You remember that I told you that the moth made a hole through the cocoon to get out. Well, this spoils the silk, so that when people want the silk good they put the cocoons into hot water, and that kills the chrysalis. The silk is then wound off the cocoon, and some day I will tell you how it is made into silk for dresses, neckties, and other things.

IV. *Summary.*—This should be written on the blackboard during the progress of the lesson, and should consist of simple words and sentences. The children should then write these sentences on their slates—

The silkworm is a kind of cat-er-pil-lar. It has sixteen legs and fourteen eyes. It eats the leaves of the mulberry-tree.

The silkworm spins a ball of yellow silk. We call this the cocoon.

The silkworm changes four times. An egg, a cat-er-pil-lar, a chrys-a-lis, and a moth.

Silk is used for making dresses and ties.

LESSON—SPOON, KNIFE, AND FORK.

CLASS—THE BABIES.

Apparatus:—Spoon, knife, ana fork (a plated and steel fork).

I. The spoon, knife, and fork should be placed before the children, and after the children have named each they should be exercised in pointing to them when named.

II. *Description.*—Where have you seen these things before? At home. When do you see them? At breakfast-time, at dinner-time, and at tea-time. Tell me one name for these different times? Meal-times. Now look at the spoon. What can you tell me about it? It is white and bright. What do you call the part I am touching? The handle. And this part? The bowl. And this? The edge. What shape is the handle? Flat, and wider than the middle part. What can you say about the middle part? It is long and round. But this one? It is long and flat on each side. How many sides? Four.

What can you say about the bowl? Can you make your hand something like the bowl of the spoon? Yes, you have to bend it to make a hollow place. What is the use of this? It is used for holding tea, coffee, sugar, etc. Would you be able to take up tea in your spoon if the bowl were flat like the handle? What is the use of the handle? For what do we use spoons? To stir our tea, coffee, etc.; and to taste with. Sometimes we want spoonfuls of things, so then we use the spoon for a measure. Tell me some things your mother measures with the spoon. Tea, sugar, spice, and medicine.

When do we use spoons like this? (Teacher to hold up a small spoon.) At breakfast and tea-time. What do we call them? Tea-spoons. Have you seen any other kind of spoons? Yes, we have spoons at dinner-time. What can you tell me about those? They are much larger. Do you know what we call them? Table-spoons. Who uses the table-spoon? Our mother. For what does she use it? To serve us with potatoes, cabbage, etc. Would tea-spoons do for this? Why not? They would not be large enough to hold potatoes. The children should then repeat 'A spoon has a handle. A spoon has a bowl. We take hold of the handle when we use a spoon. We use spoons to eat our bread and milk with, to stir our tea, and eat our pudding.'

Now I will have a little boy to pick up the knife for me. Of which part of the knife does he take hold? The handle. Is this handle like the handle of the spoon? Do you know how they are different? The handle of the spoon is like the other part of the spoon; but the handle of the knife is quite different to the other part. What colour is the handle of the knife? Do you know of what it is made? Of bone. Who can touch another part of the knife? What part did Harry touch? The blade. Yes, and you must mind and touch it very carefully. Can you tell me why? Because it is very sharp. But what then? It might cut our fingers. So you see it is better for little children not to touch knives. Who uses them? Our mothers and fathers and our big brothers and sisters. For what do they use them? To cut bread, meat, and a great many other things. When they use knives how do they hold them? They take hold of the handles. With which hand? The right hand. If you look at a knife you will see that the edges are not alike. What can you

say about this one? It is very thin. Which edge do we call this? The front or sharp edge. And what can you say about this one? It is the back of the knife. And what else? It is not sharp. Why do we not have both edges sharp? Because we should cut our fingers when cutting the bread, etc. The children should then repeat, 'A knife has a blade and a handle. The blade of the knife has a sharp edge. It is used for cutting our food.'

Now who can tell me what else I have on the table? A fork. Come and pick up the fork for me. Which fork is most like the knife? This one. How is it like the knife? It has a handle like the knife? Yes, this has a bone handle. What is the handle of this fork like? It is like the handle of the spoon. Well, we will talk about the one like the knife. We call it a steel fork, because like the blade of the knife, it is made of steel. Has it a blade like the knife? No, it has not a blade. What do you see instead of a blade? Three pieces of steel. How do they feel? Very sharp at the ends. What will they do if you put them close up to your hand? They will prick it. We call these the '*prongs*.' How many prongs has this fork? Three. For what do we use the fork? To hold our meat when we want to cut it; and to put our food into our mouths. Why do we not use our knives for this? Because we might cut ourselves. Would not the spoon do? Yes, but not to hold things with when we want to cut them. Of what use are the prongs? They stick into the meat and hold it still. Ought little children to play with forks? No, they would hurt themselves if the prongs were to stick into them.

Now look at this fork. Which part is like the spoon? The handle. And how else is it like the spoon? It is all in one piece, and of the same metal. Most people now use forks like this one. How many prongs has it? Four. How many has this steel one? Three. Which one has the more? How many more?

The children should then repeat, 'The fork has a handle. It has three sharp-pointed prongs. We use a fork to keep our food still when we want to cut it with the knife. We put the food into our mouths with a fork.'

(*To be continued.*)

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The Discipline of the Mind.

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CHAPTER I.—*continued.*

More subtle is the question whether the 'unconscious' operations of mind are in every case rendered possible by previous acts of consciousness, whether aptitudes and immediate intuitions are processes of painful volition and arduous reflection, which have lost through repetition their emotional accompaniments, and so have seemed to have fallen out from the psychical into the physical order. Without attempting to decide this question, we may say, that when we seek to fathom the depths of our mental being we find ourselves in the presence of a vague spiritual atom, or rather molecule, which we find it hard to describe as either conscious or unconscious. Not wholly unconscious, for it is dimly represented; nor plainly conscious, for it is only the phenomenon at a much later stage that we feel of right deserves that appellation. This elementary molecule has both a passive and an active aspect, at once perceiving and striving, and forms the germinal vesicle from which (duly nourished) is hereafter expanded the rich organism with its myriad ramifications and blendings of thoughts, emotions, and volitions.

My readers will perhaps recognise my meaning more plainly if I translate this psychical elementary molecule into *Sensation;* and I have no objection to do so, if they will also take my meaning that the sensation is not simply a passive state of affection, but an active state of persisting or striving not to be. On no other terms can I consent to allow of the substitution. The matter is far too vital a one to be rendered uncertain by verbal associations. For the implication is no other than this, that the essence of Will is an ultimate fact of our mental constitution, no less original than feeling or cognition.

We will take sensation, then, as the undifferentiated matter of mind. Sensations arise either through change in the environment external to the organism as a whole, or to portions of it, as in those vaguer sensations which we locate with difficulty, or which arise in consequence of altered states of the blood circulation. Or they take the form of a consciousness concomitant with centrally-initiated movement, and thus reveal in germ that active phase of mind, which, in its most developed form, we are wont to regard as the supreme mental phenomenon.

The simplest phase of this psychical activity is familiarly known as the act of Attention—a phenomenon so uniformly present, during the waking state at least, that it is not seldom made co-extensive with consciousness itself. And, indeed, there is even some warrant for this, for Attention shades so finely into Inattention that it is difficult to mark the outer zone where simple *awareness* expresses the fact, and yet where subsequent reflection shows the mind must have been on the alert. The case of the somnambulist is sometimes cited as decisive of the reality of the distinction. The somnambulist carefully avoids obstacles, even performing feats of dexterity beyond the power of the same individual in the waking state, but apparently going through his various operations without being cognizant of the outward causes of his sensations, the receptivity being perfect, but perception *nil*. And it is at least a plausible suggestion that in such a state certain regions of the brain are entirely dormant, just those regions, in fact, which are aroused into activity when we exert a volition in that incipient form which we are so prone to consider as the essence of Cognition, the reaction of the mind whereby we trace our sensations to a producing object.

This act of the mind whereby we leave the primitive ground of sensibility, hold our sensations, as it were, at arm's length from us, and present them to ourselves as *objects*, is termed Perception; and the lowest animal, no less than the highest man, has this power, although doubtless the perceived object means something very different to the animal than it does to the man. It means something very different, because to man this intuited object means a Not Self, an item of apprehension which could not be possible to a being which had not risen to a higher stage of conscious existence than bare perception.

Although the theoretical psychologist is accustomed to separate sensation from perception, and to insist upon the priority of the former, it is very doubtful whether pure sensation is a fact of conscious experience. We learn in physics that action and reaction are equal and opposite, and in psychophysics, or psychology, it is not improbable that action and passion are an inseparable pair. It is true that

the localization of sensation is often vague in the extreme, but it is difficult to imagine an unlocalized sensation. Now this localizing of sensation is a characteristic feature of perception, a localization, which, it should be observed, is due not to some ready-formed extra-mental attribute, but to the mind's own energy. Were we only passive our sensations would only have intensive, but not extensive quantity; we might discriminate difference of degree of feeling, acuteness and massiveness of sensation, but we should not spread out these sensations into a continuum, not assign them a relation of co-adjacence as well as of co-intension.

The life of perception is more or less immediate or concrete. Although the actual basis of subjective affection may be small, the experience is essentially real, and although the additions from ideal memory may be considerable, we are warranted in regarding the perceiving attitude as the attitude of reality *par excellence*. But when the stimulus is removed we drop from the public sphere of reality, and are left in the realm of private ideality. A man's perceptions are not his alone; in possessing them he participates in a common life; but a man's memories and thoughts are his and his alone. The vivid percept is first degraded to the faint image, and the image finally loses all form and colour in the idea.

Another expression for this sequence of events is that conscious life consists in a passage from the concrete to the abstract. The primary experience exhibits the maximum of concreteness. The world of the young child is a world of actual vivid feeling, absolutely articulated, a robe of perception without a seam. As some of the causes of its impression are uniformly withdrawn it finds a difference of colouring in its experience, and learns to distinguish between the objects actually present and the paler surviving relics of its memory. By transposition of stimuli, moreover, the fixity of primary association is infringed, and the youthful mind learns to partition its experience, and to form a more precise representation of the world of things.

The multiplication of experiences does something more than this, however; it makes the retention of images more and more difficult, and the necessity of keeping pace with a world in such constant flux and progress reduces the major part of these images into signs. The process here alluded to is the mental attribute termed Abstraction, and the ability to perform such an act indicates an immense advance in intellectual power.

But now, did the control of conscious experience end there it would never have been possible to define man as *animal rationale;* for rationality implies operation not on particular, but on *general* signs, and to effect that an instrument must be constructed which shall facilitate representative knowledge, which shall not only enable the mind to *perceive* a lion from a certain odour or colour, but allow the mind in its solitude to *think* lion, as in the unspoken judgment 'lions are dangerous beasts,' without any concrete reminder, either through the medium of the sense-organ or the internal organ of imagination.

For thought, for reasoning, we require a mental algebra, and the quantities of this algebra are termed *Conceptions.* The concept is related to the percept as the *a*'s and *b*'s of common algebra to the pebbles and other discrete objects of daily experience. By its aid the single rational intuition may do duty for numberless sensible intuitions, and we can carry on a train of thought that without such a symbolic language would have been impossible.

From the system of sense to the system of thought we creep thus gradually. To us of the present day the chasm seems inconceivably vast between the prevailing life of perception of the brute and the prevailing life of conception of the civilised man, but the gulf may not really be so great as it seems. The missing link —the origin of language—will doubtless be detected by the penetrating eye of future science.

The civilised child, as standing nearer to the primitive age of the race, leads a life still largely perceptional. To try and *force* the youthful mind beyond its constitutional capacity to the higher stages is both vain and injurious. A premature absorption in reflection and abstraction not only atrophies the body, but also engenders a barren schematism, in which the mind spends precious time in the fruitless working of a new instrument, without the application to material, for which the instrument is alone desirable. But as time goes on, the operations on signs rather than on the things signified must make up a large part of the doings of consciousness, and *judging* and *reasoning* be the daily portion.

Very early indeed the habit is formed of striving to enlarge the area of experience by purely rational processes. Uneducated and educated alike are prone to make universal assertions on the strength of a very slender amount of evidence, the practical utility of an 'all' giving, doubtless, the cue to this usually erroneous extension of the known. If we are to believe the school-books, the counter process is even more common, of pushing the vast stock of supposed general truths, whether derived from tradition or through the operation just described, into all their consequences. But I take leave to doubt whether this 'deductive' operation, as it is technically termed, is really as general as our logical teachers would give us to understand. The actual state of the case seems to be far rather that alleged by J. S. Mill, when he maintains that the primitive and common mode of inference is from particulars to particulars on the ground of superficial resemblances. We *induce* or make general assertions on the strength of a few instances fast enough; but we rarely deduce, or reason downwards from assumed general principles, unless our vocation lie, as with the judge or the mathematical physicist, especially in this direction.

The performance of the intellectual operations of which mention has been made is never *unmotived*, although the motive may not always be self-evident or even conscious. Will, as I hinted above, is, in my opinion, not synonymous with volition, the former being a genus, of which the latter is a species. A volition I define as an act of the mind, determined by a motive distinctly presented to consciousness, and a large number of our activities, although plainly mental or subjective, do not possess these consciously realized antecedents. While, then, in the case of many centrally-initiated activities it is hard to say why and how they arise, when once they are set on foot, and generate associations and intellectual combinations, of various orders, they are either continued in virtue of something else than their own momentum, or retarded by another cause than their own inertia. All acts of the mind are with rare exceptions accompanied by a conscious ingredient termed pleasure or pain.

They either cause delight or occasion a sense of displeasure. The exceptional cases are when the physical or psychical stimulus is, in relation to the excitability of the system, of so limited an amount as to arouse the mind from its torpor and nothing more, or when by long action of the stimulus, the mind has grown accustomed to the new condition, an increment or decrement of stimulus being required to change its tone.

When the pleasure or the pain is detached from its intellectual surroundings, and made a distinct object by consciousness, volition occurs, and we are said to work for a specific end. What ends we should work for, and what motives to the will we should suppress by a counter effort, in view of a still greater good, is the problem of the discipline of the will—a subject of supreme importance, which will subsequently require a paper to itself. I will here only make the psychological observation that the work of volition must not be judged by the complexity of the impelling motives. It is not the circumstance of deliberation and resulting resolution that is the characteristic mark of a voluntary act, but the initiating of movement itself. Whether the motives be one or a hundred, will is always there when the mind is strained to effect a certain purpose.

The conflict of motives just alluded to, however, introduces us to the circumstance hitherto passed by in silence, that the mind is often the theatre of intense struggle; that, indeed, as the tendency to regard volition as emerging from conflict shows, it is an internal sea, where perfect calm is rather the exception than the rule, and violent storms alternate with gentle breezes. The definition of man as *animal rationale* is indeed partial in the extreme. The emotions are not the least permanent or least important part of our mental constitution, and the culture of the emotions presents even a more difficult problem than that of the intellect. A wrong heart is at least as mischievous as a wrong head, and there is not a little danger that in our anxiety to avoid the intellectual aberrations of our ancestors, and to make the mind a better mirror of the rational order than heretofore, we may leave to chance the training of the instinctive feelings, and the social sympathies, and so let the tares of lawless impulse choke the wheat of knowledge we have so sedulously sown. If the motive of intellectual veracity obtain by strenuous habit complete sway over the wandering trains of thought and a too eager imagination, the mind will be still ill-prepared for encountering the real stress of actual life, unless the motive of moral veracity, and a strict regard to the legitimate feelings and rights of others, constrain individual action to a perfect harmony with social needs and endeavours.

The contents and purport of this introduction may be thus briefly summarised. The education of youth, to be successful, that is, to fit the child to play a worthy part in after-life, must be in obedience to the laws of mind. A complete understanding of these laws would require a thorough knowledge of the antecedents of the particular mind. Such antecedents are and always will be for the most part unknown. The most we can hope for is to understand the general workings of the mind, assuming a uniformity of operation under approximately uniform conditions. The teacher will, however, as far as circumstances permit, carefully note deviations from the normal type, and vary his practical rules in accordance with the peculiarities of the case. The business of the psychologist is to trace out the statics and dynamics of a typical human mind, to resolve compound mental operations into their proximate and ultimate elements, and to explain the mechanism by which mental results are obtained. The practical teacher will accept these theoretical inductions and deductions from the hands of psychologists, and will be guided by them in practice, possibly repaying the debt by collecting fresh facts for the elucidation of the theorist, the favourable opportunity possessed by him of witnessing the development of minds from a comparatively early age having as yet been hardly sufficiently utilised.

The maxim which has been found so fruitful in other departments will bear excellent fruit here likewise: 'Follow nature,' understanding by nature in the present instance those co-existences and sequences which have been established by the psycho-physical adhesive growths of centuries, which we may modify, but cannot undo.

(To be continued.)

Chemistry of the Non-Metallics.

BY EDWARD B. AVELING, D.SC. LONDON.

[This series of articles, whilst dealing with the subjects required by the University of London for the Matriculation Examination and with those required at the Elementary Stage of the Inorganic Chemistry (Branch X.) Science and Art Department, is intended as a practical guide to the philosophical and systematic study of the non-metallics.]

CHAPTER III.

Hydrogen. ὕδωρ (hudor) = water, γεννάω (gennao) = I form. It is one of the elements of water.

SYMBOL. WEIGHT-NUMBER. PREPARATIONS. THE METRIC SYSTEM. LAW OF VOLUMES. ACIDS AND ALKALIES.

A. SYMBOL.—H.

B. WEIGHT-NUMBER.—1.

C. PREPARATIONS.—First preparation. From zinc and sulphuric acid.

(1) *Laboratory Method.*—Take a double-necked bottle, commonly called a Woulff's bottle, and fit its necks with two corks. A wide-mouthed flask may be used in place of the doubled-necked bottle (Fig. 2). In the former case bore both corks; in the latter bore two holes

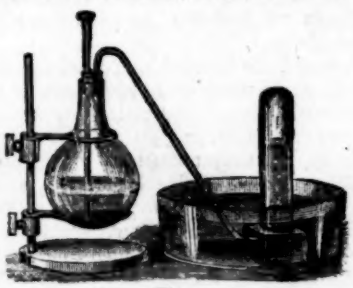


Fig. 2.

in the one large cork with which you fit the mouth of the flask. As one hole is to be traversed by a thistle-funnel, and the other by a piece of glass tubing, use cork-borers a little less in diameter than the tube of the thistle-funnel and the glass tubing respectively. Wet the borer, and push and turn it at the same time; beginning at the small end of the cork. Pass through one cork the thistle-funnel, after wetting or greasing it. Here also push and

twist simultaneously. Let the funnel tube go through the cork to such a length, that it will nearly reach the bottom of the bottle. Before introducing the glass tubing into the other cork, the tubing must be bent as in the figure, or bent twice; once at right angles at a point that will afterwards be near the cork, once at an obtuse angle at a point some 6 or 8 inches from the cork. To cut the piece of tubing off from a length of tubing, a notch is made with a file in the glass, by drawing the file, not too vigorously, across it, until it has eaten into the glass. The cut may be extended in a circle round the tubing, and then the latter being laid on the thumbs and over-grasped by the fingers, the cut lying between the two forefingers, pressure with the thumbs, and

Fig. 3.

gentle drawing with the hands to right and left, cause the tube to break with a clean fracture. If the edges are not quite smooth, heat them in the flame of a Bunsen burner (Fig. 3), directed upon the glass by aid of a blow-pipe (Fig. 4).

Fig. 4.

To bend the glass tubing. Hold it in the upper part of the flame of a batwing gas-burner, a burner with a long narrow aperture, turning it round and round. When the glass softens, bend it steadily but slowly at the required angle, after removing it from the flame.

Introduce one end of the piece of glass-tubing that has been bent twice, once at a right angle and once at an obtuse angle, into the other cork, or pass it through the second hole in the single large cork. Let it only just pass into the bottle. To the other end of this delivery-tube attach a piece of india-rubber tubing, and to the remote end of the latter a piece of glass tubing bent upwards at its free end.

Partially fill a pneumatic trough with water, and place in the water a bee-hive or hollow cylinder of earthenware, with a hole in the top, and with part of one side cut away (Fig. 5.) Fill with water several gas-jars, and

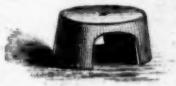


Fig. 5.

invert them in the trough, taking care that no air enters, no water escapes. Let the end of the delivery-tube pass into the bee-hive through the cut-away side-wall.

Place in the bottle some granulated zinc. Pour through the funnel enough water to cover the zinc and the lower open mouth of the thistle-funnel. Then add sulphuric acid (hydrogen sulphate) through the same channel, taking care that the proportion of water to acid is about 12 to 1. The zinc is dissolved by the acid and takes the place of the hydrogen, forming a salt, zinc sulphate, that is left in solution within the bottle. The hydrogen gas thus displaced escapes through the delivery-tube, and after expelling the air from the bottle, rises through the water in the trough and escapes at the opening in the top of the bee-hive. When you judge that all the air has been expelled, and that hydrogen is now bubbling off, pass a gas-jar on to the bee-hive, letting no water escape, and allow the gas to displace the water in the gas-jar. When the jar is full of gas and empty of water, pass it from the bee-hive on to a plate-glass plate that serves to close the lower open mouth, and remove the jar filled with hydrogen from the water. It should be kept mouth downwards. Catch three or four jars' full in this way, and then catch one or two by displacement of air, holding the jars mouth downwards, and closing each jar when you think it is full of hydrogen, with the glass plate.

The zinc used in this experiment must not be pure zinc. Upon pure zinc the action of sulphuric acid is *nil*, unless a drop or two of a solution of some lead or copper salt is placed in the vessel. Then, as the zinc is rendered impure, action takes place, and hydrogen is evolved.

In this preparation, zinc and hydrogen sulphate become hydrogen and zinc sulphate.

(2) *Symbols.*—$Zn + H^2SO^4 = H^2 + ZnSO^4$. Zn stands for the metal zinc: H^2SO^4 for the hydrogen sulphate or sulphuric acid, which consists of two atoms of hydrogen, one of sulphur, four of oxygen. H^2 represents the hydrogen that passes off: $ZnSO^4$ the zinc sulphate left in the bottle, and made up of one atom of zinc, one of sulphur, four of oxygen.

(3) *Weights and Volumes.*—Zn has weight-number 65 approximately (see table in last number, p. 12). H = 1, S = 32, O = 16. Hence—

$$\underset{65}{Zn} + \underset{98}{H^2SO^4} = \underset{2}{H^2} + \underset{161}{ZnSO^4},$$

i.e., 65 parts by weight of zinc, treated with ninety-eight parts by weight of hydrogen sulphate, yield 2 parts by weight of hydrogen and 161 parts by weight of zinc sulphate.

Volume has only reference to bodies in the gaseous condition, and in this experiment hydrogen is the only gas concerned. H^2 represents two atoms or two volumes.

We are already using the words weight, volume, atom. Let us once for all make clear the meaning of these words.

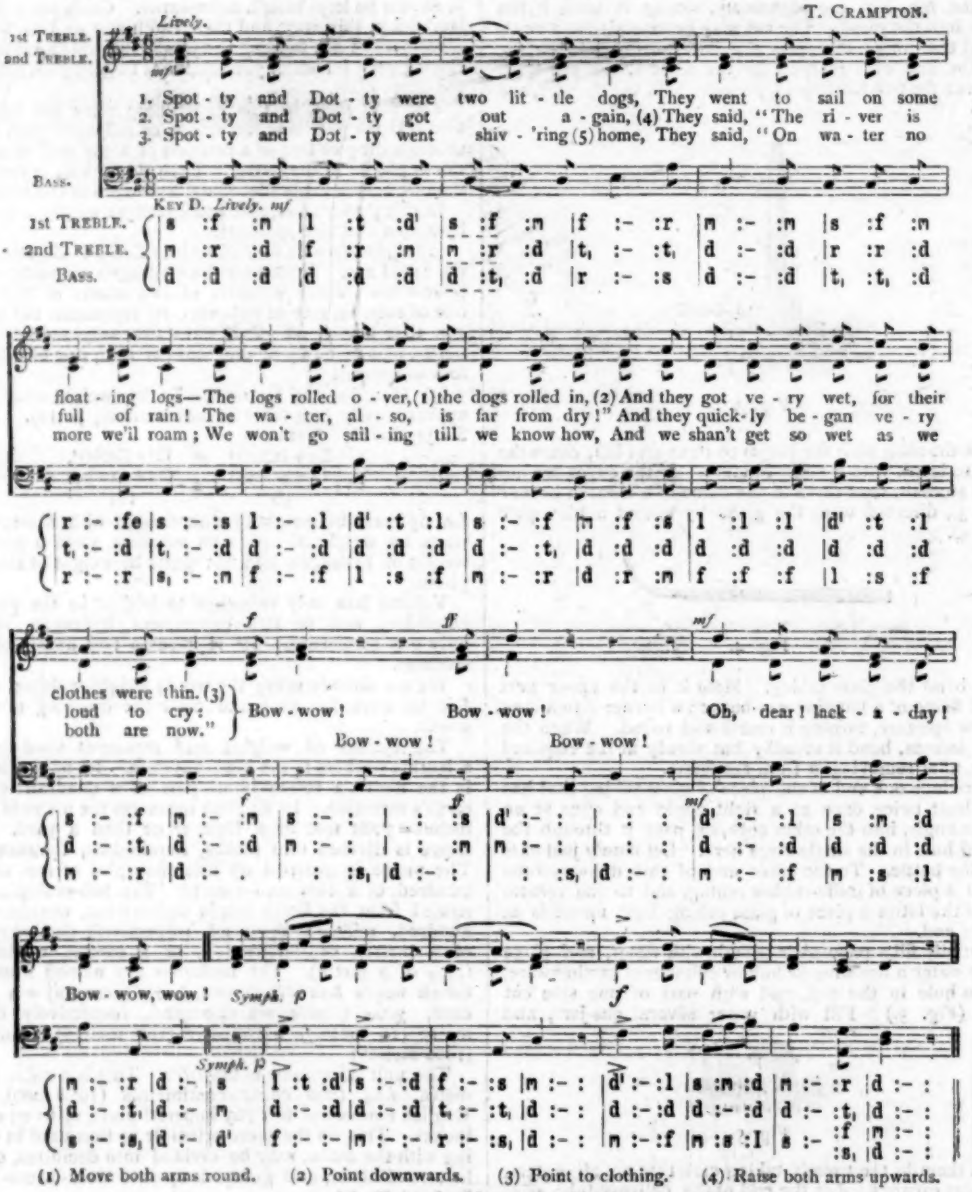
The system of weights and measures used by all scientific workers is the metric system. Its unit of length is the metre, a ten-millionth part of a quadrant of the earth's meridian. In English measures the metre is 39·37 inches = 3·281 feet or a little more than a yard. The metre is divided into tenths, hundredths, thousandths. The metre is grouped up into multiples of ten, of one hundred, of a thousand metres. The sub-multiples are named from the Latin words decem = ten, centum = one hundred, mille = a thousand, respectively decimetre ($\frac{1}{10}$ of a metre), centimetre ($\frac{1}{100}$ of a metre), millimetre ($\frac{1}{1000}$ of a metre). The multiples are named from the Greek words δεκα (deka) = ten, ἑκατον (hecaton) = a hundred, χιλιοι (chilioi) = a thousand, respectively decametre (10 metres), hectometre (100 metres), kilometre (1000 metres).

The unit of volume is the *litre*. This is a cubic decimetre, *i.e.*, 1000 cubic centimetres ($10^3 = 1000$). Its English equivalent is 1·765 imperial pints, or 61·03 cubic inches. This, on the same principle as that used in dealing with the metre, may be divided into decilitres, centilitres, millilitres, and grouped up into deca-hecto-kilolitres.

The unit of mass, or quantity of matter, and of weight, is the *gram*. This is the mass or weight of a cubic centimetre of distilled water at a temperature of 4°C, and under a pressure equivalent to that of a column of mercury 760 millimetres in height. Its English equivalent is 15·432 grains. This is divided into decigrams, centigrams, milligrams, and is grouped up into decagrams, hectograms, kilograms.

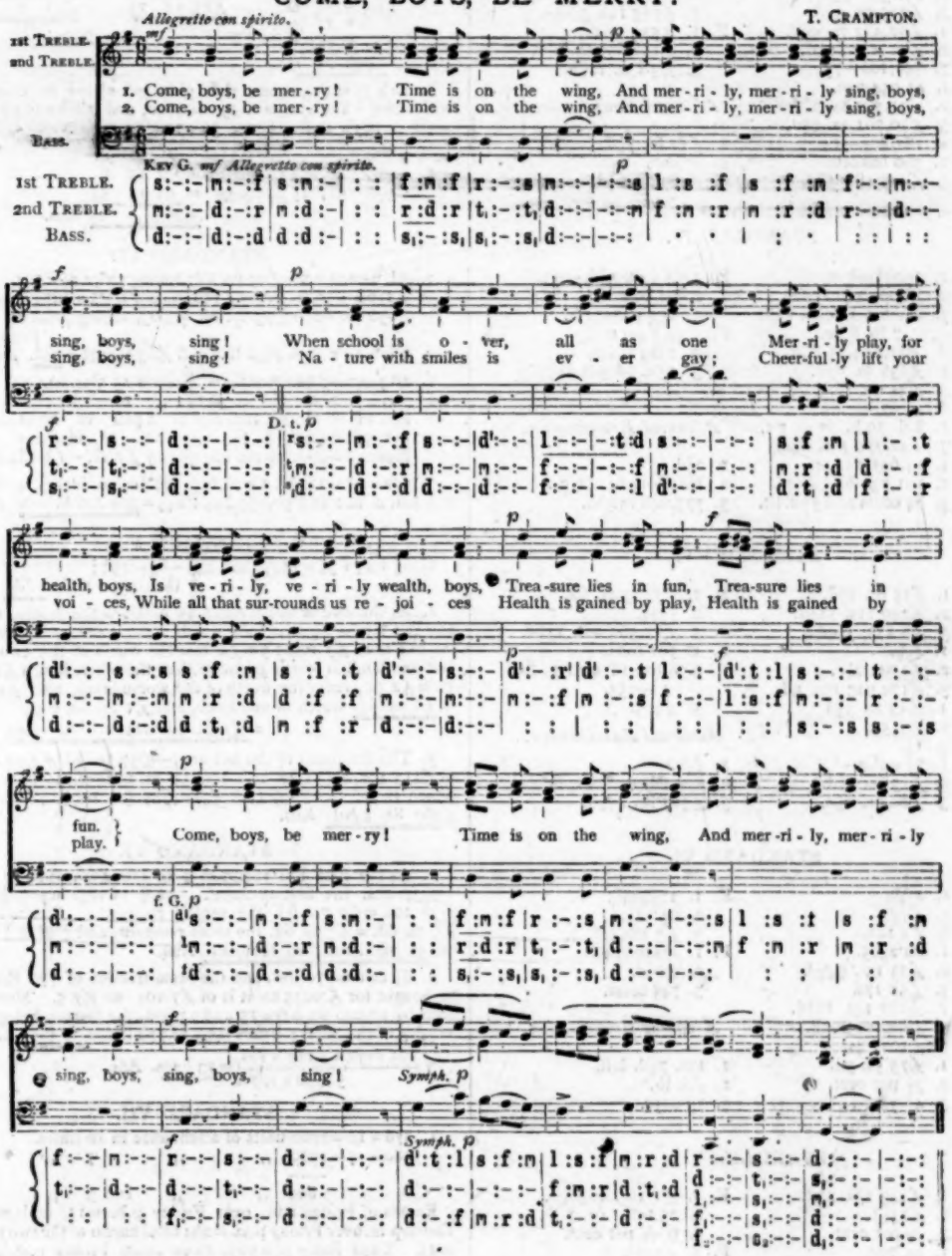
(To be continued.)

SPOTTY AND DOTTY.

T. CRAMPTON.

1st TREBLE.
2nd TREBLE.
BASS.
Lively.
mf
1. Spot - ty and Dot - ty were two lit - tle dogs, They went to sail on some
2. Spot - ty and Dot - ty got out a - gain, (4) They said, "The ri - ver is
3. Spot - ty and Dot - ty went shiv - 'ring (5) home, They said, "On wa - ter no
KEY D. Lively. mf
float - ing logs—The logs rolled o - ver, (1) the dogs rolled in, (2) And they got ve - ry wet, for their
full of rain! The wa - ter, al - so, is far from dry!" And they quick - ly be - gan ve - ry
more we'll roam; We won't go sail - ing till we know how, And we shan't get so wet as we
clothes were thin. (3)
loud to cry:
both are now."
Bow - wow!
Bow - wow!
Oh, dear! lack - a - day!
Bow - wow!
Bow - wow!
Bow - wow, wow!
Symph. p

(1) Move both arms round. (2) Point downwards. (3) Point to clothing. (4) Raise both arms upwards.
(5) Shrug shoulders as in shivering.

COME, BOYS, BE MERRY!

T. CRAMPTON.

Allegretto con spirito.
mf
1st TREBLE.
2nd TREBLE.
BASS.
1. Come, boys, be mer-ry! Time is on the wing, And mer-ri-ly, mer-ri-ly sing, boys,
2. Come, boys, be mer-ry! Time is on the wing, And mer-ri-ly, mer-ri-ly sing, boys,
KEY G. mf Allegretto con spirito.
sing, boys, sing! When school is o-ver, all as one Mer-ri-ly play, for
sing, boys, sing! Na-ture with smiles is ev-er gay; Cheer-ful-ly lift your
D. t. p
health, boys, Is ve-ri-ly, ve-ri-ly wealth, boys, Trea-sure lies in fun, Trea-sure lies in
voi-ces, While all that sur-rounds us re-joi-ces Health is gained by play, Health is gained by
fun.
play.
Come, boys, be mer-ry! Time is on the wing, And mer-ri-ly, mer-ri-ly
f. G. p
sing, boys, sing, boys, sing! Symph. p
Symph. p

ANSWERS TO ARITHMETICAL QUESTIONS IN THE 'SCHOLAR' FOR APRIL, 1884.

STANDARD III.

A. 1. 2,247,716—4
2. 85,250—73.
3. £723 5s. 3¾d.
B. 1. £97,434 7s. 9¾d.
2. £5231 5s. 9¼d.
3. 342,106—75.
C. 1. 41,944,240.
2. £32,592 8s. 2¾d.
3. £70,701 2s. 6¼d.
D. 1. 187,804—14.
2. 360 baskets.
3. £499 18s. 5¾d.

E. 1. 1152 lb.
2. 6,561,586 farthings.
3. £793 11s. 3¾d.
F. 1. 6,521—6287
2. £158,690 6s. 6¾d.
3. £3 13s. 10¼d.

Advanced Examination.

1. £11 8s. 7¼d.
2. 40 nuts.
3. £289 2s. 0¾d.

STANDARD IV.

A. 1. 312¾ inches.
2. £7 4s. 4¼d—360.
3. 212 ton 11 cwt. 1 qr. 7 lb. 6 oz.
B. 1. £71,064 3s. 0¾d.
2. £236 5s. 8¼d.
3. £31 9s. 1d.
C. 1. £147.
2. 8 d. 19 h. 37 m. 5 s.
3. £12,772 15s. 6¾d.
D. 1. 14,691,540 sec.
2. 101,730 halfpence.
3. 84 coats and ¼ yd. 1ft.

E. 1. £3 4s. 5¼d.—93.
2. 96 boards.
3. 152,460 sq. ft.
F. 1. £5 4s. 10d.
2. 2304 pints.
3. 15 c. yd. 9 ft. 1457 in.

Advanced Examination.

1. 3¾d.
2. Hand-made, £1 5s.
3. 373,248 bricks.

STANDARD V.

A. 1. £75 8s. 1¼d.
2. £249 11s. 11¼d.
3. £6 17s. 3$\frac{33}{64}$d.
B. 1. 4$\frac{1}{20}$.
2. £1 3s. 0¼d.
3. £172,913 10s. 9d.
C. 1. £13 2s. 5¼d.
2. £9555.
3. 1$\frac{1}{2}$.
D. 1. 3$\frac{3}{4}$ miles.
2. £15 8s. 0¾d.
3. £82 9s. 2¼d.

E. 1. £5103 2s. 6d.
2. 3$\frac{1}{3}\frac{1}{3}$.
3. £17,560 10s. 11¼d.
F. 1. 101 tons.
2. 8 ton 18 cwt. 12 lb. —153.
3. £405.

Advanced Examination.

1. $\frac{7}{1\,0\,0}$.
2. 27s. 6d. and 22s. 6d.
3. £367 8s. 4$\frac{5}{1\,6}$d.

STANDARD VI.

A. 1. 2$\frac{7}{1\,0\,0}$.
2. £$\frac{4\,4}{1\,0\,0}$.
3. £1 10s.
B. 1. 86·2365.
2. £73 13s. 9$\frac{5}{8\,8}$d.
3. £52 17s.
C. 1. £137 14s. 1¼d.
2. 4 inches thick.
3. £1027 4s.
D. 1. £75 5s. 3d.
2. 3½ per cent.
3. 4½ years.

E. 1. 17$\frac{1}{2}\frac{1}{3}\frac{1}{6}\frac{1}{2}$.
2. 24·354.
3. £5 18s. 4$\frac{2}{3}$d.
F. 1. 645996+.
2. £660.
3. 74$\frac{1}{2}$ acres.

Advanced Examination.

1. 15s. 7¾d. left.
2. $\frac{7\,7}{1\,0\,0}$ lb.
3. 73 days.

STANDARD VII.

A. 1. £443 13s. 2¾d.
2. £7354.
3. $\frac{5}{1\,6}$ per cent.
B. 1. 1s. 7¾d.
2. 5s. 11$\frac{3}{4}$d.
3. £73 15s. 4$\frac{3}{8}\frac{3}{2}$d.
C. 1. 4$\frac{1}{1}\frac{1}{6}\frac{1}{2}$ per cent.
2. £11 9s. 8$\frac{1}{2}\frac{1}{4}$d.
3. £68 8s. 6·912d.
D. 1. 11s. 8¾d.
2. 97$\frac{1}{2}$.
3. 6s. each.

E. 1. £1 10s. 10$\frac{4}{1\,0\,0}$d.
2. 25 ton 1 qr. 7 lb.
3. 9$\frac{5}{1\,0}$ per cent.
F. 1. £2365.
2. £140.
3. 21$\frac{1}{2}$ per cent. gain.

Advanced Examination.

1. 255 present.
2. £450.
3. 2 per cent. gain.

SOLUTIONS OF THE 'ADVANCED EXAMINATION' QUESTIONS IN 'THE SCHOLAR' FOR APRIL, 1884.

STANDARD III.

1.

£	s.	d.
14	17	6
21	12	6
0	17	9
0	17	9
0	17	9
£39	3	3

£	s.	d.
27	10	0
0	4	7½
£27	14	7½

£	s.	d.
39	3	3
27	14	7½
£11	8	7½

Ans.

2. 10 × 35 = 350, excess that girls get above an equal share with boys. Then 2150 − 350 = 1800, and 1800 ÷ (25 + 35 = 60) = 30, a boy's share, hence 30 + 10 = 40, a girl's share. Ans.

3.

	£	s.	d.
46,173 twopences =	384	15	6
91,845 farthings =	95	13	5¼
	£289	2	0¾

Ans.

STANDARD IV.

1. 5d. × 2240 × 2 = £93 6s. 8d. selling price of 2 ton.
£120 + £36 6s. 8d. = £156 6s. 8d. total selling price.
£156 6s. 8d. − £93 6s. 8d. = £63, selling price of 1 ton 16 cwt.
1 ton 16 cwt. = 4032 lb., and £63 ÷ 4032 = 3¾d. Ans.

2. 10 years or 120 months = 8 times 15 months.
" " = 12 " 10 "
14s. 6d. × 8 = £5 16s. cost of 8 pair of hand-made.
11s. 9d. × 12 = £7 1s. " 12 " machine "
Hence *hand-made* are cheaper by £7 1s. − £5 16s. = £1 5s.

3. 972 × 27 × 1728 × 2 = 90,699,264 *half* c. inches, and 121½ = 243 half c. in.; and 90,699,264 ÷ 243 = 373 248 bricks. Ans.

STANDARD V.

1. 6¾ + 4½ + 3⅞ = 15$\frac{9}{8}$, and 24⅜ − 8⅛ = 15$\frac{8}{8}$;
then 15⅜ − 15$\frac{9}{8}$ = $\frac{7\,2}{6\,4}$. Ans.

2. As the ewe is worth *twice* as much as the lambs, the ewe and the lambs *together* are worth *three times* as much as the lambs; then £7 10s. ÷ 3 = £2 10s. the worth of the two lambs. But one lamb is worth 5s. more than the other, hence £2 10s. − 5s. = £2 5s., *twice* the worth of the worse lamb, and £2 5s. ÷ 2 = £1 2s. 6d. worth of one lamb, and £1 2s. 6d. + 5s.
= £1 7s. 6d. worth of the other. Ans.

3. The five items of the bill are :—£39 7s. 9d. + £48 12s. 2d. + £113 12s. + £31 4s. 10cd. + £159 1s. 6d. = £391 18s. 3d.; on which 1s. 3d. in the £ (*i.e.* $\frac{1}{1\,6}$) = £24 9s. 10½$\frac{1}{1\,6}$d., leaving net £367 8s. 4$\frac{5}{1\,6}$d. Ans.

STANDARD VI.

1. As the first bill required ⅜ of the £60, then ⅜ of £60 = £37 10s. the first remnant. As ⅜ of *this* was paid, ⅜ of £37 10s. = £9 7s. 6d. the second remnant. Similarly, ⅜ of £9 7s. 6d. = £3 2s. 6d. the third remnant, and ⅜ of £3 2s. 6d. = 15s. 7½d., the final remnant. Ans.

2. 6$\frac{7}{1\,0}$ cwt. = 770 lbs., and the same fraction of 770 lbs. could be bought for £·0075 as it is of £7 10s. or £7·5. Multiplying both by 10,000 we have 75 and 75,000, the former being $\frac{7\,5}{7\,5\,0\,0\,0}$ = $\frac{1}{1\,0\,0\,0}$ of the latter; hence $\frac{1}{1\,0\,0\,0}$ of 770 lbs. = ·77 lbs. Ans.

3. $\frac{365 \text{ days} \times £1\not{0}\not{0} \times 1\not{5}\text{s.}}{5\ £9\not{0} \times 1\not{0}\not{0}\text{s.}}$ = 73 days. Ans.

STANDARD VII.

1. 276 × 10 = 2760 units of attendance in 10 times.
280 × 7 = 1960 " " 7 "
800 " " last 3 "
Excess of Friday a.m. over Friday p.m. = 15, and excess of Thurs. p.m. over Friday p.m. = 20; total excess of the two together = 35. Then 800 − 35 = 765, *three* times Friday p.m.'s attendance, and 765 ÷ 3 = 255. Ans.

2. £1 would amount to £1·124864; then £506·1888 ÷ £1·124864 = £450. Ans.

3. At the former price the globes that cost £100 would sell for £85, then at the latter price they would sell for ⅞ of £85 = £102, selling price of £100's worth of globes; hence 2 per cent. gain. Ans

Query Column.

RULES.

1. Each correspondent is restricted to *one question*. We should be much obliged if correspondents, who send questions for solution, would give (if possible) the required answer, and the source from which the question is obtained.

2. No query can be answered unless accompanied by the real name and address of the sender, not necessarily for publication, but as a guarantee of good faith and for facility of reference.

3. ☞ When a pseudonym is adopted it should be written at the end of the query, and the real name and address on a separate piece of paper.

4. Correspondents are requested to write their queries *legibly*, and on one side of the paper only.

5. Replies will not be sent through the post.

6. Queries must reach the office *not later than the 12th of the month*, or they cannot be attended to in the following issue.

*** All communications for this column should be addressed—'*The Query Editor*,' *The Practical Teacher*, *Pilgrim Street, Ludgate Hill, London, E.C.*

Arithmetic.

1. BONA DEA.—If I buy 3 per cents. at 78⅜ and 3½ per cents. at 95 5/16, which is the better investment? If I had invested £6,962 19s. 3¾d. in each, and the former rose and the latter fell 1/16, how much should I lose or gain?

First stock : Second stock :: $\frac{3}{78\frac{3}{8}} : \frac{3\frac{1}{2}}{95\frac{5}{16}}$,

:: $\frac{24}{627} : \frac{112}{1523}$,

:: $\frac{24}{627} \times 1523$,

:: $8 \times 1523 : 28 \times 209$,

:: 12,184 : 5,852;

∴ 3 per cents. at 78⅜ is the better investment.

£ 78⅜ : £ 6,962 19s. 3¾d. :: £ 1/16 : Gain on First investment.

8

627

2

1254)6,962 19 3¾

£5 11 0⅛ Gain.

£ 95 5/16 : £ 6,962 19s. 3¾d. :: £ 1/16 : Loss on Second investment.

16

1523

= £4 11s. 5½d. Loss.

∴ Gain = £5 11s. 0⅛d. − £4 11s. 5½d.

= 10s. 7⅛d.

2. BESTIA.—If the 3 per cents. be at 91, how much must a person invest in order that he may have a yearly income of £460, after paying 7d. in the pound for income tax? (*Barnard Smith.*)

s. d. £ £

19 5 : 460 :: 1 : Income with income-tax.

12

233

$= \frac{460 \times 240}{233}$ £ $= \frac{110400}{233}$ £.

£ £ £

∴ 3 : $\frac{110400}{233}$ :: 91 : Amount invested.

$= \frac{110400 \times 91}{3 \times 233}$ £ $= \frac{10045200}{699}$ £

= £14,372 10s. 7 5/699d. Ans.

Note.—Your writing is *very good*, and we cannot suggest any improvement.

3. H. F. C.—A farmer went to market and spent £100. He bought 100 animals, consisting of bullocks, sheep, and ducks. For each bullock he gave £5, for each sheep £1, and for each duck one shilling. How many of each did he buy?

Average price = £100 ÷ 100 = £1;

Difference between price of bullocks and average price = £5 − £1 = £4;

Difference between price of ducks and average price = £1 − 1s. = 19s.;

∴ No. of bullocks : No. of ducks :: 19s. : £4,

:: 19 : 80.

∴ No. of bullocks = 19

,, ducks = 80

,, sheep = 100 − (19 + 80)

= 100 − 99

= 1

} Ans.

4. JENNIE.—A owes B a debt payable in 7 3/10 months, but he pays ⅓ in 4 months, ¼ in 6 months, and ⅕ in 8 months; when ought the remainder to be paid? (*Barnard Smith.*)

(4 months × ⅓) + (6 months × ¼) + (8 months × ⅕)

+ [Time for remainder × {1 − (⅓ + ¼ + ⅕)}] = 7 3/10 months,

4/3 months + 3/2 months + 8/5 months

+ $\left\{\text{Time for remainder} \times \left(1 - \frac{20+15+12}{60}\right)\right\}$ = 7 3/10 months,

$\frac{40+45+48}{30}$ months + {Time for remainder × (1 − 47/60)}

= 7 3/10 months,

133/30 months + (Time for remainder × 13/60) = 7 3/10 months,

Time for remainder × 13/60 = 7 3/10 months − 133/30 months,

$= \frac{211 - 133}{30}$ months,

= 78/10 months

= 13/5 months,

12

∴ Time for remainder = $\left(\frac{13}{5} \times \frac{60}{13}\right)$ months

= 12 months. Ans.

Note.—About 70 per cent.

5. M. R. S.—Two pieces of silver plate are melted down together; the first weighs 3 lbs. 4 oz. and contains 9 per cent. of alloy, and the second weighs 5 lbs. 5 oz. and contains 6 oz. of alloy; find the percentage of pure silver in the whole mass.

Weight of pure silver in first piece = 3 lbs. 4 oz. × 91/100

2

$= \frac{52 \times 91}{100}$ oz.

5

= 36⅖ oz.;

,, ,, ,, second ,, = 5 lbs. 5 oz. − 6 oz.

= (65 − 6) oz.

= 59 oz.;

Weight of the whole mass = 3 lbs. 4 oz. + 5 lbs. 5 oz.

= (40 + 65) oz.

= 105 oz.;

,, ,, pure silver in the whole mass

= (36⅖ + 59) oz.

= 95⅖ oz.;

∴ Percentage of pure silver in the whole mass

159 4

$= \frac{95\frac{2}{5}}{105} \times 100 = \frac{477 \times 20}{100 \quad 21}$

7

$= \frac{380}{7} = 90\frac{2}{7}$%. Ans.

6. TEACHER.—Two clocks point to 2 o'clock at the same instant on the afternoon of Christmas day; one loses 8 seconds,

and the other gains 9 seconds in 24 hours; when will one be half an hour before the other, and what time will each clock then show? (*Brook Smith.*)

sec. min. day
17 : 30 :: 1 : Time for difference of ½ hour.

$= \frac{30 \times 60}{17}$ days $= \frac{1800}{17}$ days $= 105\frac{15}{17}$ days
$= 105$ days 21 hrs. 10 min. $35\frac{5}{17}$ sec.

∴ Time = 10 min. $35\frac{5}{17}$ sec. past 11 a.m. on April 10th.

Time lost by first clock $= (105\frac{15}{17} \times 8)$ sec.
$= 847\frac{1}{17}$ sec.
$= 14$ min. $7\frac{1}{17}$ sec.;
,, gained ,, second ,, $= 30$ min. $- 14$ min. $7\frac{1}{17}$ sec.
$= 15$ min. $52\frac{16}{17}$ sec.;
∴ Time shown by first clock $= 56$ min. $28\frac{4}{17}$ sec. past 10 a.m.,
or 3 min. $31\frac{13}{17}$ sec. to 11 a.m.;
Time shown by second clock $= 26$ min. $28\frac{4}{17}$ sec. past 11 a.m.

7. OXONIAN.—A man invested a sum of money in $4\frac{1}{2}$ per cent. stock at $1\frac{1}{4}$ per cent. premium, and allowed the investment to accumulate at simple interest. The stock went down in value for 9 years at the average rate of $\frac{1}{2}$ per cent., and then improved in value for 5 years at the average rate of $\frac{1}{4}$ per cent., at the end of which time he was able to draw out £49,387 10s. What sum did he invest?

Increase for an investment of £101¼
$= (£4\frac{1}{2} \times 14) + (£\frac{1}{4} \times 5) - (£1\frac{1}{4} \times 9)$
$= £63 + £1\frac{1}{4} - £1\frac{1}{4} = £63\frac{1}{4}$;
Amount drawn out for an investment of £101¼
$= £101\frac{1}{4} + £63\frac{1}{4} = £164\frac{1}{2}$;
£ £ £
∴ 164½ : 49,387½ :: 101¼ : Sum invested.
8 4 2
1317 197555 203
150
$= £30,450$. Ans.

8. PUPIL TEACHER.—In a subscription list, one-half of the subscriptions are a guinea each, one-third 10s. 6d. each, and the 4s. subscriptions, which complete the list, amount to £10. Find the amount subscribed. (*Caxton* Arithmetical Test Cards.)

No. of subscriptions at 4s $= £10 \div 4s.$
$= 200s. \div 4s. = 50$;
,, ,, ,, ,, $= \{1 - (\frac{1}{2} + \frac{1}{3})\}$ of the whole number
$= \frac{1}{6}$ of the whole number;
∴ Total number of subscriptions $= 50 \times 6 = 300$;
∴ Amount subscribed $= (£1\ 1s. \times 150) + (10s.\ 6d. \times 100) + £10$
$= £157\ 10s. + £52\ 10s. + £10$
$= £220$. Ans.

9. W. E. MILTON.—A bill falls due in 6 months. The creditor agrees to accept immediate payment of one half, and to defer payment of the other half for one year. He finds by this arrangement, reckoning interest at 6 per cent. per annum, he gains 9s. What is the amount of the bill?

Suppose amount of bill were £100;
Amount at end of year $= £100 + (6\%$ on $£50) = £103$.
Interest on £100 for 6 months at $6\% = £3$;
£ £ £
∴ 103 : 100 :: 100 : Present worth of bill.
$= \frac{10000}{103}$ £;
Amount at end of year $= £\frac{10000}{103} \times \frac{106}{100}$
$= £\frac{10600}{103} = £102\frac{94}{103}$;
∴ Gain $= £103 - £102\frac{94}{103} = £1\frac{9}{103}$;
£ s. £
∴ $\frac{9}{103}$: 9 :: 100 : Amount of bill.
$= (103 \times 5)$ £ $= £515$. Ans.

10. DANDRUM.—A church clock is set at 12 o'clock on Saturday night; at noon on Tuesday it is 3 minutes too fast. Supposing its rate regular, what will be the true time when the clock strikes four on Thursday afternoon? (*Barnard Smith.*)

Time from 12 o'clock on Saturday night to noon on Tuesday $= 2$ days 12 hrs.;
Time from 12 o'clock on Saturday night to four o'clock on Thursday afternoon $= 4$ days 16 hrs.;

dys. hrs. min. dys. hrs. min.
∴ 2 12 3 : 4 16 :: 3 : Time gained.
24 24
60 112
60 60
1803 6720
1201 $= 5\frac{715}{1201}$ min.
∴ True time $= 5\frac{715}{1201}$ min. to 4.

11. J. L. E. N.—There are three candidates at an election, at which it is necessary that at least one more than half the entire number of electors should vote for the successful candidate. A fails to obtain an absolute majority, although he has twenty votes more than B; but C, whose votes are only three-tenths of B's, withdraws, and one-fourth of his supporters vote for A on the second ballot. A is then successful, without, however, a vote to spare. How many votes were given to each candidate on the first occasion? (*Cassell's Saturday Journal.*)

(1) A's voters + B's voters + C's voters = No. of electors.
That is B's voters + 20 + B's voters + $\frac{3}{10}$ of B's voters
= No. of electors,
$2\frac{3}{10}$ times B's voters = No. of electors − 20,
∴ B's voters = (No. of electors − 20) × $\frac{10}{23}$.

(2) A's voters + ¼ of C's voters = ½ No. of electors + 1,
B's voters + 20 + ¼ of $\frac{3}{10}$ of B's voters = ½ No. of electors + 1,
$1\frac{3}{40}$ times B's voters = ½ No. of electors − 19,
∴ B's voters = ($\frac{1}{2}$ No. of electors − 19) × $\frac{40}{43}$.

∴ ($\frac{1}{2}$ No. of electors − 19) × $\frac{40}{43}$ = (No. of electors − 20) × $\frac{10}{23}$,

$$\frac{4\ (\frac{1}{2}\text{ No. of electors} - 19)}{43} = \frac{\text{No. of electors} - 20}{23},$$

92 ($\frac{1}{2}$ No. of electors − 19) = 43 (No. of electors − 20),
46 times No. of electors − 1,748 = 43 times No. of electors − 860,
46 times No. of electors − 43 times No. of electors = 1,748 − 860,
3 times No. of electors = 888,
∴ No. of electors = 296.
∴ B's voters = (No. of electors − 20) × $\frac{10}{23}$
= (296 − 20) × $\frac{10}{23}$ = 276 × $\frac{10}{23}$,
= 12 × 10 = 120;
A's voters on the first occasion = 120 + 20
= 140;
C's ,, ,, ,, ,, = $\frac{3}{10}$ of 120
= 36.

12. HAWTHORN.—In a tricycle race the rates of speed of A, B, and C, are as 7 : 6⅔ : 5⅔ for the first half of the course. A slackens at completing this, and C increases his speed on doing so, B travelling at the same rate throughout. The rates of speed consequently for the second half of the course are as 5½ : 6⅔ : 6½. In what order do they reach the goal?

A's time : B's time : C's time

$$:: \frac{\frac{1}{2}\text{ course}}{7} + \frac{\frac{1}{2}\text{ course}}{5\frac{2}{3}} : \frac{\text{course}}{6\frac{2}{3}} : \frac{\frac{1}{2}\text{ course}}{5\frac{1}{2}} + \frac{\frac{1}{2}\text{ course}}{6\frac{1}{2}},$$

$$:: \tfrac{1}{14} + \tfrac{1}{11\frac{1}{3}} : \tfrac{3}{20} : \tfrac{3}{22} + \tfrac{3}{26},$$

$$:: \frac{11+14}{154} : \frac{3}{20} : \frac{110+92}{1265},$$

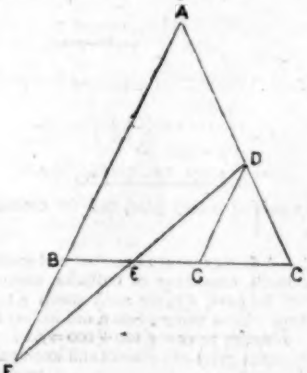
$$:: \tfrac{25}{154} : \tfrac{3}{20} : \tfrac{202}{1265},$$

:: 25 × 53 × 115 : 8 × 154 × 115 : 202 × 14 × 53,
:: 152,375 : 141,680 :: 149,884.
∴ B arrives first, C second, and A last.

Note.—Your writing is *good*, but it is too fine.

Geometry.

1. ADDLE-PATED.—A straight line is drawn, terminated by one of the sides of an isosceles triangle, and by the other side produced, and bisected by the base; show that the straight



lines, thus intercepted between the vertex of the isosceles triangle and this straight line, are together equal to the two equal sides of the triangle. (*Potts.*)

Let ABC be an isosceles triangle, and let the straight line DEF be drawn, bisected by the base in E, meeting AC in D, and AB produced in F.

Then the straight lines FA, AD shall be together equal to AB, AC, that is, BF shall be equal to CD.

Draw DG parallel to AB (I. 31), meeting BC in G.

Proof.—In the triangles FBE, DGE,

$\angle FEB = \angle DEG$, (I. 15.)

$\angle FBE = \angle DGE$, (I. 29.)

And side FE = Side DE, (Hyp.)

$\therefore$ Side BF = Side DG. (I. 26.)

Again, in the triangle DGC,

$\angle DGC = \angle ABC$, (I. 29.)

And $\angle DCG = \angle ABC$, (I. 5.)

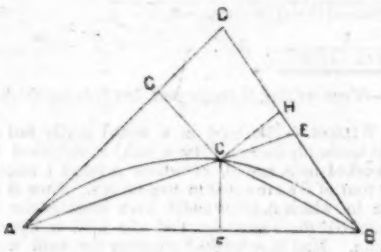
$\therefore \angle DGC = \angle DCG$, (Ax. 3).

Wherefore side DC = Side DG, (I. 6.)

But BF = DG;

$\therefore$ BF = DC. (Ax. 3.) Q. E. D.

2. CRICKETARIAN.—Given the base, the vertical angle, and the radius of the inscribed circle of a triangle, construct it. (*Todhunter.*)



Construction.—Upon the given base AB describe a segment of a circle, containing an angle equal to the sum of the vertical angle and half its supplement; (III. 33.)

At a distance from AB equal to the given radius draw a straight line parallel to AB, and meeting the arc in C;

Join AC, BC;

Make the angle CAD equal to the angle CAB, and the angle CBE equal to the angle CBA;

Produce BE to meet AD in D;

Then ADB shall be the triangle required.

Draw CF, CG, CH perpendicular to AB, AD, BD respectively.

Proof.—Because $\angle ACB$ = Vertical angle and half its supplement,

$\angle$s CAB, CBA = Half the supplement (I. 32.)

And their equals, $\angle$s DAC, DBC = Half the supplement;

But $\angle ACB = \angle$s CBE, BEC (I. 32.)

$= \angle$s CBE, EAD, ADE, (I. 32.)

That is, $\angle$s DBC, DAC, ADB;

$\therefore \angle$s DBC, DAC, ADB = Vertical angle and half its supplement,

And $\angle$s DBC, DAC = Half the supplement,

$\therefore \angle ADB$ = Vertical angle.

Again, in the triangles CAG, CAF,

$\angle CAG = \angle CAF$, (Con.)

$\angle CGA = \angle CFA$, (Ax. 9.)

And side CA is common to the two triangles,

$\therefore$ Side CG = Side CF; (I. 26.)

Similarly it can be proved that CH = CF;

$\therefore$ CF, CG, CH are equal.

Wherefore C is the centre of the inscribed circle (III. 9.), and ADB is the required triangle. Q. E. F.

Mensuration.

1. KNUDSEN.—How many paving stones, each of them a foot long and $\frac{4}{5}$ of a foot wide, will be required for paving a street 45 feet wide, surrounding a square, the side of which is 225 feet?

Area of street $= \{(225+45) \times 45 \times 4\}$ sq. ft.

$= (270 \times 180)$ sq. ft. $= 48{,}600$ sq. ft.;

Area of each stone $= 1$ ft. $\times \frac{4}{5}$ ft. $= \frac{4}{5}$ sq. ft.;

$\therefore$ No. of stones required $= 48{,}600 \div \frac{4}{5} = 12{,}150 \times 15$

$= \underline{182{,}250}$. Ans.

2. TREWERRY.—The area of a square cricket-field is 9 ac. 3 ro. 8·16 po. A running path of the uniform width of 3·9 yards is constructed close to the boundary of the field at a cost of 4d. per square yard, and the remainder of the field is laid down in turf at a cost of 5s. 6d. per hundred square yards. Find the total cost of preparing the field. (*Cambridge Senior*, December, 1874.)

9 ac. 3 ro. $\underline{8{\cdot}16}$ po. $= 1{,}568{\cdot}16$ po.;

Side of field $= \sqrt{1{,}568{\cdot}16}$ po. $= 39{\cdot}6$ po.

$= 217{\cdot}8$ yds.;

Area of path $= \{(217{\cdot}8 - 3{\cdot}9) \times 3{\cdot}9 \times 4\}$ sq. yds.

$= (213{\cdot}9 \times 15{\cdot}6)$ sq. yds;

$= 3{,}336{\cdot}84$ sq. yds.;

Cost " " $= \frac{3336{\cdot}84}{3}$s. $= 1{,}112{\cdot}28$s.

$= £55\ 12\text{s.}\ 3\frac{9}{25}\text{d.}$;

Area of turfed part $= [\{217{\cdot}8 - (3{\cdot}9 \times 2)\}^2]$ sq. yds.

$= 210^2$ sq. yds. $= 44{,}100$ sq. yds.;

Cost " " $= 5\text{s.}\ 6\text{d.} \times 441 = £121\ 5\text{s.}\ 6\text{d.}$;

$\therefore$ Total cost of preparing the field

$= £55\ 12\text{s.}\ 3\frac{9}{25}\text{d.} + £121\ 5\text{s.}\ 6\text{d.}$

$= \underline{£176\ 17\text{s.}\ 9\frac{9}{25}\text{d.}}$ Ans.

3. JACK AND JILL.—A closed vessel formed of metal, 1 inch thick, whose external dimensions are 8 ft. 3 in., 7 ft. 5 in., and 4 ft. 3 in., weighs 3 cwt. 1 qr. 8 lbs. What would be the weight of a solid mass of metal of the same dimensions? (*Brook Smith.*)

Solidity of vessel $= [(8 \text{ ft. } 3 \text{ in.} \times 7 \text{ ft. } 5 \text{ in.}) + \{8 \text{ ft. } 3 \text{ in.} \times (4 \text{ ft. } 3 \text{ in.} - 2 \text{ in.})\} + \{(7 \text{ ft. } 5 \text{ in.} - 2 \text{ in.}) \times (4 \text{ ft. } 3 \text{ in.} - 2 \text{ in.})\}] \times 1 \text{ in.} \times 2.$

$= [\{(99 \times 89) + (99 \times 49) + (87 \times 43)\} \times 2]$ cub. in.

$= \{(8{,}811 + 4{,}851 + 4{,}263) \times 2\}$ cub. in.

$= (17{,}925 \times 2)$ cub. in. $= 35{,}850$ cub. in.;

Content of a solid mass of the same dimensions

$= 8$ ft. 3 in. $\times 7$ ft. 5 in. $\times 4$ ft. 3 in.

$= (99 \times 89 \times 51)$ cub. in. $= 449{,}361$ cub. in.

Cub. in.	Cub. in.	cwt.	qrs.	lbs.	
$\therefore$ 35850	: 449361	:: 3	1	8	: Weight of solid mass.

5975 | 62 | 4

898722 | 13

2696166 | 28

27860382 | 371

62

5975)27860382(4662

23900

39603

35850

37538

35850

16882

11950

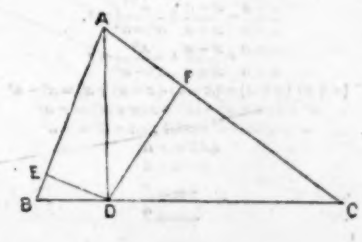
4932

$= 4{,}662\frac{4932}{5975}$ lbs. $= 166$ qrs. $14\frac{4932}{5975}$ lbs.

$= \underline{2 \text{ tons } 1 \text{ cwt. } 2 \text{ qrs. } 14\frac{4932}{5975} \text{ lbs.}}$ Ans.

Note.—Your capital letters are the principal defects in your writing.

4. H. T.—ABC is a triangle, and AD is the perpendicular from A on BC. If AD = 13 feet, and the lengths of the perpendiculars from D on AB and AC be 5 feet and 10·4 feet respectively, find the sides and the area of the triangle. (*Todhunter.*)



$AE^2 = AD^2 - DE^2$
$= 13^2 - 5^2$
$= 169 - 25$
$= 144$
$\therefore AE = 12.$

$AF^2 = AD^2 - DF^2$
$= 13^2 - 10{\cdot}4^2$
$= 169 - 108{\cdot}16$
$= 60{\cdot}84$
$\therefore AF = 7{\cdot}8.$

The triangle ADB is right-angle, and DE is the perpendicular on the hypotenuse AB,

$\therefore AE \times EB = DE^2$
$12 \times EB = 5^2 = 25$
$\therefore EB = \frac{25}{12}.$

Similarly, $AF \times FC = DF^2$
$7{\cdot}8 \times FC = 10{\cdot}4^2 = 108{\cdot}16$
$\therefore FC = 108{\cdot}16 \div 7{\cdot}8 = \frac{1352}{78}.$

$BD^2 = DE^2 + EB^2$
$= 5^2 + (\frac{25}{12})^2$
$= 25 + \frac{625}{144}$
$= \frac{4225}{144}$
$\therefore BD = \frac{65}{12}.$

$DC^2 = DF^2 + FC^2$
$= (\frac{52}{10})^2 + (\frac{1352}{78})^2$
$= \frac{2704}{100} + \frac{1827904}{6084}$
$= \frac{676000}{2500}$
$= \frac{27040}{100}$
$\therefore DC = \frac{520}{10}.$

$AB = AE + EC$
$= (12 + 2\frac{1}{10})$ ft.
$= 14\frac{1}{10}$ ft.

$AC = AF + FC$
$= (\frac{78}{10} + \frac{520}{10})$ ft.
$= \frac{117 + 208}{15}$ ft.
$= \frac{325}{15}$ ft.
$= \frac{65}{3}$ ft.
$= 21\frac{2}{3}$ ft.

$BC = BD + DB$
$= (\frac{65}{12} + \frac{65}{12})$ ft.
$= \frac{65 + 208}{12}$ ft.
$= \frac{273}{12}$ ft. $= \frac{91}{4}$ ft.
$= 22\frac{3}{4}$ ft.

Area of triangle $ABC = (BC \times AD) \div 2 = (\frac{91}{4} \times \frac{13}{5})$ sq. ft.
$= 11\frac{37}{40}$ sq. ft. $= 147\frac{7}{40}$ sq. ft.

5. NELLIE.—Find the area of the surface of a cube, which contains 733,626,753,859 cubic inches.

Side of cube $= \sqrt[3]{733,626,753,859}$ cub. in.

	733,626,753,859	(9,019
	729	
$90^2 \times 300 =$	2,430,000	4,626,753
$90 \times 1 \times 30 =$	2,700	
$1^2 =$	1	
	2,432,701	2,432,701
$901^2 \times 300 =$	243,540,300	2,194,052,859
$901 \times 9 \times 30 =$	243,270	
$9^2 =$	81	
	243,783,651	2,194,052,859

Surface of cube $=$ Side$^2 \times 6 = (9,019$ in.$)^2 \times 6$
$= 81,342,361$ sq. in. $\times 6$
$= 488,054,166$ sq. in. Ans.

Algebra.

1. H. BULL.—Solve:—

$\sqrt{2x} + \sqrt{2x-3} = 3.$
$\sqrt{2x} + \sqrt{2x-3} = 3$
$\sqrt{2x-3} = 3 - \sqrt{2x}$
$2x - 3 = 9 - 6\sqrt{2x} + 2x$
$6\sqrt{2x} = 12$
$\sqrt{2x} = 2$
$2x = 4$
$\therefore x = 2.$

Note.—You will notice that the above solution is simpler than yours. You made an error in working it, or you would have obtained the same result.

2. H. DAWSON.—Solve:—

$$\frac{x+a}{x-a} - \frac{x-a}{x+a} + \frac{x^2}{x^2-a^2} = 1.$$
$$\frac{x+a}{x-a} - \frac{x-a}{x+a} + \frac{x^2}{x^2-a^2} = 1$$
$(x+a)(x+a) - (x-a)(x-a) + x^2 = x^2 - a^2$
$x^2 + 2ax + a^2 - (x^2 - 2ax + a^2) = -a^2$
$x^2 + 2ax + a^2 - x^2 + 2ax - a^2 = -a^2$
$4ax = -a^2$
$4x = -a$
$\therefore x = -\frac{a}{4}.$

3. WAT TYLER.—Find the value of

$$\frac{1}{(a-b)(a-c)(x-a)} + \frac{1}{(b-a)(b-c)(x-b)} + \frac{1}{(c-a)(c-b)(x-c)}. \quad (Todhunter.)$$

$$\frac{1}{(a-b)(a-c)(x-a)} + \frac{1}{(b-a)(b-c)(x-b)} + \frac{1}{(c-a)(c-b)(x-c)}$$
$$= \frac{1}{(a-b)(a-c)(x-a)} - \frac{1}{(a-b)(b-c)(x-b)} + \frac{1}{(a-c)(b-c)(x-c)}$$
$$= \frac{(b-c)(x-b)(x-c) - (a-c)(x-a)(x-c) + (a-b)(x-a)(x-b)}{(a-b)(a-c)(b-c)(x-a)(x-b)(x-c)}$$
$$= \frac{(b-c)(x^2 - bx - cx + bc) - (a-c)(x^2 - ax - cx + ac) + (a-b)(x^2 - ax - bx + ab)}{(a-b)(a-c)(b-c)(x-a)(x-b)(x-c)}$$
$$= \frac{bx^2 - b^2x + b^2c - cx^2 + c^2x - bc^2 - ax^2 + a^2x - a^2c + cx^2 - c^2x + ac^2 + ax^2 - a^2x + a^2b - bx^2 + b^2x - ab^2}{(a-b)(a-c)(b-c)(x-a)(x-b)(x-c)}$$
$$= \frac{a^2b - a^2c + ac^2 - ab^2 + b^2c - bc^2}{(a-b)(a-c)(b-c)(x-a)(x-b)(x-c)}$$
$$= \frac{(a-b)(a-c)(b-c)}{(a-b)(a-c)(b-c)(x-a)(x-b)(x-c)}$$
$$= \frac{1}{(x-a)(x-b)(x-c)}. \quad \text{Ans.}$$

Note.—Your writing is *pretty good*, but it is too thick.

4. J. WILSON.—The hold of a vessel partly full of water (which is uniformly increased by a leak) is furnished with two pumps worked by A and B, of whom A takes 3 strokes to B's two, but four of B's are equal to five of A's. Now B works for the time in which A alone could have emptied the hold. A then pumps out the remainder, and the hold is cleared in 13 hrs. 20 min. Had they worked together the hold would have been emptied in 3 hrs. 45 min., and A would have pumped out 100 gallons more than he did. Required the quantity of water in the hold at first, and the horary influx at the leak. (*Wood*).

Let x = No. of gals. pumped out by A in an hour,
Then, $x \times \frac{2 \times 5}{3 \times 4}$ or $\frac{5x}{6}$ = No. of gals. ,, ,, B ,, ,,
And let y = ,, ,, in hold at first,
Also ,, z = horary influx at the leak in gals.;
$\therefore \frac{y}{x-z}$ = No. of hours in which A alone could have emptied the hold.

$$\therefore \text{(1)} \left(\frac{5x}{6} \times \frac{y}{x-z}\right) + x\left(13\tfrac{1}{3} - \frac{y}{x-z}\right) = y + (z \times 13\tfrac{1}{3})$$
$$\text{(2)} \left(x + \frac{5x}{6}\right) \times 3\tfrac{3}{4} = y + (z \times 3\tfrac{3}{4})$$
$$\text{(3)} \quad x\left(13\tfrac{1}{3} - \frac{y}{x-z}\right) = (x \times 3\tfrac{3}{4}) - 100$$

(1) $\frac{5xy}{6(x-z)} + \frac{40x}{3} - \frac{xy}{x-z} = y + \frac{40z}{3}$
$-\frac{xy}{6(x-z)} = y + \frac{40z}{3} - \frac{40x}{3}$
$\frac{xy}{x-z} = 80x - 6y - 80z.$ (4).

(2) $\frac{11x}{6} \times \frac{3}{4} = y + \frac{15z}{4}$
$\frac{55x}{8} = y + \frac{15z}{4}$
$55x - 8y - 30z = 0.$ (5).

(3) $\frac{40x}{3} - \frac{xy}{x-z} = \frac{15x}{4} - 100$
$-\frac{xy}{x-z} = \frac{15x}{4} - \frac{40x}{3} - 100$
$\frac{xy}{x-z} = \frac{115x + 1200}{12}.$ (6).

From (4) and (6);
$\therefore 80x - 6y - 80z = \frac{115x + 1200}{12}$
$960x - 72y - 960z = 115x + 1200$
$845x - 72y - 960z = 1200$
(5) $55x - 8y - 30z = 0$

$$\left.\begin{array}{l} 845x-72y-960z=1200 \\ 495x-72y-270z=0 \end{array}\right\}$$
$$350x-690z=1200$$
$$35x-69z=120$$
$$\therefore z=\frac{35x-120}{69}$$

$$\left.\begin{array}{l} 845x-72y-960z=1200 \\ 55x-8y-30z=0 \end{array}\right\}$$
$$\left.\begin{array}{l} 845x-72y-960z=1200 \\ 1760x-256y-960z=0 \end{array}\right\}$$
$$-915x+184y=1200$$
$$\therefore y=\frac{915x+1200}{184}$$

$$(6)\quad \frac{xy}{x-z}=\frac{115x+1200}{12}$$
$$\frac{x(915x+1200)}{184}=\frac{115x+1200}{12}$$
$$x-\frac{35x-120}{69}$$
$$\frac{915x^2+1200x}{8}=\frac{115x+1200}{12}$$
$$69x-35x+120$$
$$3$$
$$\frac{3(915x^2+1200x)}{8(34x+120)}=\frac{115x+1200}{12}$$
$$\frac{2745x^2+3600x}{2(34x+120)}=\frac{115x+1200}{3}$$
$$8235x^2+10800x=(115x+1200)(68x+240)$$
$$=7820x^2+109200x+288000$$
$$415x^2-98400x=288000$$
$$x^2-\frac{19680x}{83}=\frac{57600}{83}$$
$$x^2-\frac{19680x}{83}+(\frac{9840}{83})^2=\frac{57600}{83}+\frac{96825600}{83^2}$$
$$=\frac{4780800+96825600}{83^2}$$
$$=\frac{101606400}{83^2}$$
$$x-\frac{9840}{83}=\pm\frac{10080}{83}$$
$$x=\frac{\pm10080+9840}{83}$$
$$\therefore x=240, \text{ or } -\tfrac{240}{83}.$$

The minus value is inapplicable.

$$y=\frac{915x+1200}{184}$$
$$=\frac{(915\times240)+1200}{184}$$
$$=\frac{219600+1200}{184}$$
$$=\frac{220800}{184}$$
$$=1200.$$

$$z=\frac{35x-120}{69}$$
$$=\frac{(35\times240)-120}{69}$$
$$=\frac{8400-120}{69}$$
$$=\frac{8280}{69}$$
$$=120.$$

$\therefore$ Quantity of water in hold at first = 1200 gals.
Horary influx at the leak = 120 gals.

5. VERAX II.—In how many ways can a bill of £1 9s. be paid in florins and half-crowns? (*Hamblin Smith.*)

Let x = No. of florins,
And „ y = „ half-crowns;

Then, $2x+\frac{5y}{2}=29$

$$2x=29-\frac{5y}{2}=\frac{58-5y}{2}$$
$$\therefore x=\frac{58-5y}{4}.$$

The integral values of y that give integral values of x, are
$y=2$, then $x=12$,
$y=6$, „ $x=7$,
and $y=10$, „ $x=2$;
$\therefore$ There are 3 ways, viz.,
12 florins and 2 halfcrowns,
7 „ 6 „ „
and 2 „ 10 „ „

Note.—Whenever possible, give the answers to your queries.

6. DENNY, Leamington.—A person with a capital of £a, for which he receives interest at r per cent., spends every year £b, which is more than his original income. Find in how many years he will be ruined.

Ex.—If $a=1000$, $r=5$, $b=90$, show that he will be ruined before the end of the 17th year, having given
log 2 = ·3010300, log 3 = ·4771213,
log 7 = ·8450980. (*Todhunter.*)

The present value of an annuity of £b per year is $\frac{b(1-R^{-n})}{R-1}$; it is obvious that the man is ruined if this is greater than a, that is, if $b(1-R^{-n})$ is greater than $a(R-1)$. In this case, $b=90$, $R=\frac{21}{20}$, $a=1000$; thus the man will be ruined if

$90(1-R^{-n})$ is greater than $1000(\frac{1}{20})$,
that is, if $9(1-R^{-n})$ is greater than 5,
if $1-R^{-n}$ „ „ $\frac{5}{9}$,
that is, if R^{-n} is less than $\frac{4}{9}$;

We have then to show that $\frac{1}{R^n}$ is less than $1\div\frac{5}{9}$, that is, that R^n is greater than $\frac{9}{5}$, when $n=17$.

$$\text{Log } R^{17}=17 \log R=17 \log \tfrac{21}{20}=17(\log 21-\log 20)$$
$$=17(\log 7+\log 3-1-\log 2)$$
$$=17(\cdot845098+\cdot4771213-1-\cdot30103)$$
$$=17\times\cdot0211893$$
$$=\cdot3602181;$$
$$\log\tfrac{9}{5}=\log 9-\log 4=2\log 3-2\log 2$$
$$=(\cdot4771213\times2)-(\cdot30103\times2)$$
$$=\cdot9542426-\cdot60206$$
$$=\cdot3521826;$$

$\therefore$ He will be ruined before the end of the 17th year.

7. SUBSCRIBER.—The sum of £15,050 is divided between A and B. A's money is invested in the 3 per cents. at a certain price; B's money, which exactly equals A's amount of stock, is also invested in the 3 per cents. when the price has risen £3, and B's annual income is £87 10s. more than A's. Find each investment. (*Colenso.*)

Let x = A's money,
and „ y = price of stock;

Then, (1) $\frac{100x}{y}=15{,}050-x$
(2) $3\left(\frac{15050-x}{y+3}-\frac{x}{y}\right)=87\frac{1}{2}$

(1) $100x=15{,}050y-xy$
(2) $3\left\{\frac{15050y-xy-x(y+3)}{y(y+3)}\right\}=1\frac{1}{2}$

(1) $xy=15{,}050y-100x$
(2) $6(15050y-xy-xy-3x)=175y(y+3)$
$90{,}300y-12xy-18x=175y^2+525y$
$89{,}775y-12(15{,}050y-100x)-18x=175y^2$
$89{,}775y-180{,}600y+1{,}200x-18x=175y^2$
$1{,}182x-90{,}825y=175y^2$

From (1) $x=\frac{15050y}{y+100}$

$$\therefore \frac{15050y\times1182}{y+100}-90{,}825y=175y^2$$

Dividing by $175y$:
$$\frac{86\times1182}{y+100}-519=y$$
$$101{,}652-519y-51{,}900=y^2+100y$$
$$y^2+619y=49{,}752$$
$$y^2+619y+(\tfrac{619}{2})^2=49{,}752+\tfrac{383161}{4}$$
$$=\frac{199008+383161}{4}=\tfrac{582169}{4}$$
$$y+\tfrac{619}{2}=\pm\tfrac{763}{2}$$
$$y=\pm\tfrac{763}{2}-\tfrac{619}{2}=72, \text{ or } -691.$$

The minus value is inapplicable.

$$x=\frac{15050y}{y+100}=\frac{\cancel{150}\,\cancel{50}\times72}{\cancel{172}}=6{,}300.$$

$\therefore$ B's investment = £6,300,
And A's „ = £15,050 − £6,300
= £8,750.

Note.—'The Teachers' Prayer Book,' published by Messrs. Eyre and Spottiswoode.

8. YELSERP.—A set out to walk from London to Rugby, and B at the same time from Rugby to London, a distance of 84 miles, and A reached Rugby 9 hours, and B reached London 16 hours, after they met on the road. Find in what time each performed the journey, and their rates of walking, supposed uniform.

Let x = A's rate per hour in miles,
And " y = B's " " " ;
Then, (1) $9x + 16y = 84$
(2) $\frac{9x}{y} = \frac{16y}{x}$

(1) $16y = 84 - 9x$
$\therefore y = \frac{84 - 9x}{16}$

(2) $9x^2 = 16y^2$
$= 16\left(\frac{84 - 9x}{16}\right)^2$
$= \frac{7056 - 1512x + 81x^2}{16}$

$144x^2 = 7056 - 1512x + 81x^2$
$63x^2 + 1512x = 7056$
$x^2 + 24x = 112$
$x^2 + 24x + (12)^2 = 112 + 144$
$= 256$
$x + 12 = \pm 16$
$x = \pm 16 - 12$
$\therefore x = 4$, or -28.

The minus value is inapplicable.

$$y = \frac{84 - 9x}{16} = \frac{84 - 36}{16} = 3.$$

$\therefore$ A's rate of walking per hour = 4 miles
B's " " = 3 "
A performed the journey in $\frac{84}{4}$ hours = 21 hours
B " " $\frac{84}{3}$ " = 28 "

Note.—About 90 per cent.

9. C. C.—Solve :—

$$\left.\begin{aligned} x + 2y + 3z &= 14 \\ 3x + 4y + 5z &= 26 \\ 4x + 3y + 2z &= 16 \end{aligned}\right\} \text{(Matriculation.)}$$

Although three equations are given, there are in reality only two, as any one of them can be formed from the other two, and therefore the equations are indeterminate.

Thus, adding (1) and (3),

$$\left.\begin{aligned} 5x + 5y + 5z &= 30 \\ x + y + z &= 6 \end{aligned}\right\}$$

$$\left.\begin{aligned} 2x + 2y + 2z &= 12 \\ x + 2y + 3z &= 14 \end{aligned}\right\} \text{(1)}$$

$3x + 4y + 5z = 26$ (2)

$$\left.\begin{aligned} x + 2y + 3z &= 14 \\ x + y + z &= 6 \end{aligned}\right\} \text{(1)}$$

$y + 2z = 8$
$z = \frac{8 - y}{2}$.

The positive integral values of y, that give positive integral values of x, are

(1) $y = 2$, then $z = 3$;
(2) $y = 4$, " $z = 2$;
(3) $y = 6$, " $z = 1$;
$x + y + z = 6$,

$$\left.\begin{aligned} \text{From (1)}, & \ x = 1 \\ \text{" (2)}, & \ x = 0 \\ \text{" (3)}, & \ x = -1 \end{aligned}\right\}$$

$\therefore$ The positive integral values are :—
$x = 1, y = 2, z = 3$,
And $x = 0, y = 4, z = 2$.

General.

1. G. NELIAN.—'Ellen or *me*,' in apposition to '*whom*,' object of '*likes*.' 'She does not know whom she likes the better of the two, Ellen or me.'

2. J. R. ROBERTS.—No Latin author is specified for Q. S. examination. See last year's questions to judge of their difficulty.

3. CANDIDATE.—We repeat what we have said several times, that no religious knowledge examination paper is set in July by the Education Department. But each college has its own arrangement as to this subject, the particulars of which may be obtained with the terms of admission. Some papers of the Church colleges are published by the National Society.

4. PRÆCEPTOR'S writing would pass, but his large hand is evidently 'unstudied.' As to the Latin, see answer given above (2).

5. EMPEROR might get some help from *Tancock's* 'England,' from 1765 to 1820; and *Browning's* 'Modern England,' from 1820 to 1874. Both are included in 'Epochs of English History,' published by Longmans (9d. each). 'The History of our Own Times,' by *Justin M'Carthy*, is a much larger work.

6. Y WYDDFA will perhaps find some help in *Dr. Morell's* 'Practical Introduction to English Composition,' published by Stewart. But the language must be known before it can be used.

7. WELSHMAN will be admitted to a 'Church college' not on the ground of passing the Scripture examination only. There are personal qualifications respecting health, etc., which he should ascertain by obtaining the terms of admission from the principal.

8. CYMRO DEWR.—About eighty per cent. The writing is evenly good.

9. TOM.—You will find the solution of your query in our issue for June, 1882.

10. GEORGIUS.—(1) Arrange the multiplicand, multiplier, and product according to descending powers of a or x, or as the case may be. (2) We believe your writing would obtain full marks at an examination.

11. CARLO.—The solution of your query appeared in our issue for June, 1882.

12. ALPHA.—Can any reader of the P. T. give me the name, publisher, and price of any dictionary or other work that will render me any assistance in the study of *Sir David Lyndesay's* 'Ane Satyre,' one of the English authors prescribed for the next Intermediate Arts' Examination of London University?

13. WALLACE.—The Syllabus of the Certificate Examination for 1884 was published in the *Schoolmaster* of December 22nd, 1883.

14. 'CICERO,' 'RALPHO,' 'COLLEGIAN,' and others whose queries arrived too late for the last issue, would nevertheless find answers in the replies given to several inquirers. In addition to the Epochs in English History, and *Justin M'Carthy's* 'History of our own Times,' we may name *Mackenzie's* 'History of the 19th Century.' The summary published by the *Times* is a useful chronological record. Candidates must confine themselves to *one* notation in writing music, but for the singing test either may be used. The exercises are distinct.

15. WIGTONIAN writes small hand legibly, but, like many others, has neglected to *study* the forms of letters for large hand. Parsing is called functional because words are thereby classified according to the function (or office) of each in a sentence : *e.g.*, *names* are *nouns*, etc.

16. F. G. H. writes firmly but not evenly. The Scripture questions are the same in many Church Training Colleges : enquire of the National Society, Westminster. The English Constitution, etc., by Sheldon Amos, may be useful. For this and English Dictionaries, see advertisements.

17. DESIROUS may select *any* 80 lines, according to the taste of the P. T. But let it *be* poetry, and not mere rhyme.

18. A. T. may have seen the statement repeatedly made that the marks assigned to each subject are not now published as formerly. Writing lacks freedom; not more than sixty per cent.

19. E. H. G. must also study his capitals; looped letters should not exceed them in height. Perhaps seventy.

20. R. R. F.—'Unseen' passages in Latin and French. Marks not known.

21. CZECH should get Morris or Daniel (Part III.). These grammars have been named before.

22. NECKER, after having obtained his parchment certificate, is technically 'free'; but if he has bound himself by any implied engagement to continue his services, he will remember that a teacher should be the most honourable of men.

23. G. H. A. TAYLOR.—The Code (Art. 68) prescribes an interval of two years for 're-examination' in order to raise your certificate. *Hullah's* 'Time and Tune' will serve your purpose.

24. D. M. H. is right in supposing that 'Mulhauser's System of Writing' is out of print. Canon Richson, of Manchester, has published some valuable sheets, etc, on this subject.

25. LITERATURE will find the Clarendon Press edition of Shakespeare's Richard II., and Lewis's edition of Bacon's Essays, sufficient. Dr. Abbott has also annotated the Essays (two vols., Longmans).

26. COTTONOPOLIS.—The Q.S. Examination has reference to admission for the next year's course at the College. It does not stand good for *any* subsequent year. But you may sit in successive years until you reach the top of the list, if you desire to do so. Your small-hand must be more regular.

27. ROGO.—James' book or James's book; both forms are used in writing. For Scripture questions write to the Secretary, National Society, Westminster.

28. J. F. M. BRYN.—We know of no such work.

29. EL TEB.—Custom-House officers if on duty at night, are off duty during the day. With a few special exceptions, they receive no extra pay.

30. SOLICITOR.—(*a*) 'Draw near and listen to the decision of our council:—In order that the blood of those whom this country hath bred may not be made to stain the ground; and because we hate the sight of wounds received in civil strife between neighbours; and because we think it is only pride which springs from ambition, and envy of ourselves and each other that hath stirred you up to disturb the quiet of our realm—a quiet so lately secured that if now rudely broken by the clash of arms, and all the sounds and circumstances of war, the peace of the kingdom might be completely destroyed, and the country deluged with blood,—we therefore banish you from the realm,' etc.

(*b*) No; we cannot afford the space, especially as text-books, fully annotated and published at so cheap a rate, can be procured for the purpose.

31. PUPIL TEACHER.—Your query was fully solved in our last issue, and an explanation given of scales of notation. See No. 3 in Algebra.

32. M. D.—The solution of your query appeared in our issue for May, 1882.

33. J. HEAVY HAND.—(*a*) Your writing is uneven, and many of the letters are incorrectly formed, the capitals in several places being poor. It is, however, bold and round, and with daily practice in a good copy book, will soon be a good hand.

(*b*) *A*—distinguishing adj., limiting '*few minutes*,' considered as a whole.
few—a common noun, neut., sing., obj., gov. by 'have.' a few = some, or '*a few*' = a number.
minutes—com. noun, pl., neut., obj., gov. by 'of' understood.
welcome—adj. of quality, qualifying 'you,' or person understood.

34. YOUNG GRAMMARIAN.—

Darkened—past part. of 'to darken,' referring to 'Archangel.'
so—adv. of manner, modg. 'darkened.'
above—prep., showing rel. between 'them' and 'shone.'
waiting—pres. part. of 'to wait,' refg. to 'brows.'
revenge—abs. noun, neut., sing., 3rd, obj., gov. by 'for,' understood.
cruel—adj. of quality, qual. 'eye.'
eye—com. noun, neut., sing., 3rd, nom. to 'was cruel.'
cast—irreg. trans. verb, act., ind., past., 3rd, agreeing with its nom. 'it' understood.
rather—adv. of deg., modg. 'should say,' in the sentence '*I should rather say they were the followers.*'
far—adv. of deg., mod. 'other.'
other—indef. adj., qual. 'beings' understood.
once—adv. of time, modg. 'beheld.'
beheld—past part. of 'to behold,' refg. to 'fellows.'

(The clause may be thus expanded: *They were* far other (entirely different) *beings* once, *when they were* beheld in bliss.)

condemned—past part. of 'to condemn,' refg. 'to fellows.'
for—prep., showing reln. between 'ever' and 'condemned.'
ever—adv. used as com. noun, neut., sing., 3rd, obj., gov. by 'for.'
now—adv. of time, modg. 'condemned.'

SENTENCE.	KIND OF SENT.	CONNECTIVE.	SUBJECT.	PREDICATE.	OBJECT.	EXTENSION OF PRED.
(*a*) Darkened so, yet shone above them all the Archangel.	Princ. Sent.		The Archangel, darkened so	shone		yet (time) above them all (manner)
(*b*) but his face deep scars of thunder had intrenched	Princ. Sent. adversative to (*a*)	but	deep scars of thunder	had intrenched	his face	
(*c*) and care sat on his faded cheek	Princ. Sent. co-ord. to (*b*)	and	care	sat		on his faded cheek (place)
(*d*) but under brows of dauntless courage and considerate pride waiting revenge	Princ. Sent. adversative to (*c*)	but	[it]	[sat]		under brows of dauntless courage and considerate pride, waiting revenge (place)
(*e*) cruel his eye	Princ. Sent.		his eye	[was] cruel		
(*f*) but cast signs of remorse and passions to behold the fellows of his crime, the followers rather (far other once beheld in bliss) condemned for ever now to have their lot in pain.	Princ. Sent. adversative to (*e*.)	but	[it]	cast	signs of remorse and passions	to behold the fellows of his crime, the followers rather, (far other once beheld in bliss) condemned for ever now to have their lot in pain (reason)

35. A CONSTANT READER.—The only difficulty in the line you require to be parsed is in the word 'wreck,' which may be taken in several ways. If there is a dash between *vessel* and *wreck*, then the latter word is objective case, in apposition with *vessel*. If not, then the sentence may be considered elliptical, and the ellipsis supplied thus: Drive the vessel *till she becomes* a wreck, or, Drive the vessel *which is* a wreck. Then wreck would be nominative case after *becomes* or *is*.

36. VESUVIUS.—At the foot of (Mt.) Vesuvius the country is the finest and the best-cultivated that can be found in the kingdom of Naples, that is to say, in the country of Europe, (which is) the most favoured of heaven. The celebrated vine whose wine is called *Lacryma Christi*, is found in this place, and quite close to (beside) the lands devastated by the lava. One would say that nature has made a last effort in this place adjoining the volcano, and has robed (adorned) herself in her most beautiful gifts before perishing. As one rises, one discovers, on turning round, Naples and the admirable country which surrounds it. There the splendour of creation is diminished by degrees as far as (until we reach) the land (region) of cinder and of smoke, which announces (indicates) beforehand the approach to the volcano. The lavas of preceding years trace on the soil their broad and black furrow, and all is bare (barren) around them. At a certain elevation (the) birds do not (no longer) fly; at another, plants become very rare. Then the very insects no longer find anything to subsist (upon) in this burnt-up nature. At length all that has life disappears; you enter the empire of death, and the cinder of this pulverised land alone rolls under your badly-stayed (unsteady) feet. Never does the shepherd nor the herdsman lead to this spot (place) either his (their) sheep or his herds (cattle). [This translation is nearly literal, as desired.]

37. PORTLAND.—Writing lacks care and firmness; about sixty per cent.

38. CÆSAR.—See answer to Cicero and others (14).

39. LEO can gain little from books. There must be the actual training of the voice. Elocution cannot be secured by rules merely, although these may be suggestive.

40. EIFIONFAB.—'The Science and Art of Teaching,' National Society. Writing fairly uniform; about seventy-five per cent.

41. EDWAL.—The books named will suffice if mastered.

42. READER.—In England students in training are resident, but not in Scotland. There are no 'day-pupils.'

43. COMPO.—The marks assigned to the several subjects are not known. A science, a language, and drawing, each adds to the marks to lift a candidate towards the top of the list.

44. ANXIOUS ONE can obtain a Colonial Certificate only in the colony itself. Study the formation of capitals; you may obtain sixty per cent.

45. REVILO NYLEWELL.—'Power of pen' certainly, and very regular; but the style is not the best, and would fall short of 'full marks.'

46. E. S. W.—Could you not rule three lines in the margin for the three odd days? Entries might be inserted with care in the Summary. The new Registers will begin on Thursday, May 1st. It would be better to paste on a slip in the old Register than end the year with three days in the new.

47. THOMAS CARTWRIGHT.—*Sully's* 'Psychology,' 12s. 6d. (Longmans). Many thanks for information.

[Any subscriber to the PRACTICAL TEACHER having Vol. I. to dispose of (bound or unbound), please address—'J. A., 116, Chapman Street, Great Grimsby.']

*** *Several queries are unavoidably crowded out.*

—o—

Publications Received.

Bell and Sons—
The Romance of the Coast. By P. Runciman.
Great Englishwomen.
The Light of Truth and other Parables from Nature. By Mrs. Alfred Gatty.
Enunciation of Propositions in Geometrical Conic Sections. By W. H Besant, M.A., D.Sc., F.R.S.
Formulæ and Equations. By Rev. T. W. Openshaw, M.A.

Blackie and Son—
Blackie's Graded Readers, Primers, Parts. I and II., and Complete, and Standards I. to VI.
Blackie's Comprehensive Readers, Primers, and Standards I. to VI.
Blackie's Geographical Readers. Nos. 1 and 2.

Chambers (W. and R.)—
Chambers' Historical Reader. Book II.

Grant and Co.—
How to Manage Schools. By H. Major, B.A., B.Sc.

Heywood (John)—
John Heywood's Infant Primer.

Hodder and Stoughton—
Capital for Working Boys. By J. E. McConaughty.

Isbister (W.), Limited—
The New London Readers. No. 6.

Johnston (A.)—
Johnston's Standard Diagrams of Physiography. Nos. 1 and 2 on rollers.
Johnston's Pictures for Schools. Fruit-trees: Apple, Cherry, Pear, Date, Plum, Orange.

Ledsham (J. B.)—
Ledsham's Essay Cards. By E. Noble.
Notes on Commercial Geography. By the Rev. L. C. Casartelli, M.A.
Varied Occupation Cards for Infant Classes.

Letts, Son, and Co.—
Letts's Illustrated Household Magazine. Part XIII. March.

Lewis (H. K.)—
A Comprehensive Manual of Elementary Knowledge. By J Oberlin Harris, M.A.

Longmans and Co.—
Lays of Ancient Rome. (Annotated.)
Longman's Magazine. March.
Swift's Gulliver's Travels. "Longman's Modern Series.'

Macmillan and Co.—
The English Illustrated Magazine (March).

Moffatt and Paige—
Notes on School Management. By G. Collins.

Morris (John), Chicago—
Opinions of the American Press on Mr. Henry Irving and Miss Ellen Terry.

Nelson (T.) and Sons—
Handy Register of Daily Attendance and Fees.
The New Royal Readers. No. 3.

Simpkin, Marshall, and Co.—
A Summary of English History. By L. G. Burt.
Chemical Tables for Elementary Students. By Wm. Joel Kemp.

Smith, Elder, and Co.—
The Cornhill Magazine for March.

Swan Sonnenschein and Co.—
The Naturalist's World. January, February, and March.

Systematic Bible Teaching Co.—
The Gospel Manual, Grade III.

The Educational Supply Association—
Robinson Crusoe.
1st, 2nd, and 3rd Standard Spelling Books. By G. T. Taylor.
The Eclipse Test Cards. Standards II. to VII.
The Holborn Atlas.

The National Society—
Shakspeare's Plays for Schools. King Richard II. and King Henry V. By C. M. Yonge.

Ward, Lock, and Co.—
The Universal Instructor. Part XLI.

Williams and Norgate—
The Child's First German Course. By E. Schinzel.
A German Preparatory Course. By E. Schinzel.
German Conversational Questions. By E. Schinzel.
German Method. By E. Schinzel.

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The February (1884) number of the *Practical Teacher* is now out of print.

Matriculation Hints.

BY HENRY A. REATCHLOUS, M.A. (LOND.), B.Sc.,

Westminster Training College.

IN this and subsequent papers we propose to give some help and instruction to students reading for the matriculation examination of the University of London. Though the standard is believed to be fully maintained, this examination has lost none of its popularity. We learn from the calendars that about 1,600 candidates are examined annually, of whom about one-half are rejected. It appears, however, that some subjects are more fatal than the rest: thus, taking the average of six examinations, 25 per cent. failed in Latin, 26 per cent. in Greek, 16 per cent. in French, 8 per cent. in German, 23 per cent. in mathematics, 13 per cent. in English, 27 per cent. in natural philosophy, and 13 per cent. in chemistry. These figures are only averages, and may not hold good for the next examination, but they are instructive. It is plain there are some subjects in which it is more difficult to satisfy the examiners than in others. These subjects must be studied with special care from the first. Many, no doubt, will ask, what are the chances of success? how much preparation is needed? In reply, it may be said, once for all, that without fairly good abilities and habits of systematic and persevering application, the prospects of success are not very bright. No great proficiency in any single subject is required, but there are a good many subjects, and experience shows how easy it is for a candidate to fail to satisfy the examiners in some of them. To be sure of passing, one must know the work well all round. This is impossible without diligence and perseverance; to say otherwise would lead to disappointment.

It will, no doubt, be interesting to our readers to learn that the total number of marks obtainable is 2,800; 2,000 qualify for a prize; 1,800 for honours; and 1,400 for a place in the first division. All the papers carry an equal number of marks, except the two Latin papers. No candidate can pass who does not satisfy the examiners in Latin, Greek (*or German*), French, Mathematics, English, Natural Philosophy, and Chemistry. It is believed that one-third of the marks obtainable in each subject will secure a pass, but the candidate must not rely on this; he will be sure to fail unless he aims at doing very much more. But having secured a pass, the next object should be to get a good place on the list. As this depends on the total number of marks, and as Chemistry carries as many as Greek, it is foolish to neglect any individual subject, or leave the room, as many candidates do, as soon as they have done as much as they think will just secure a pass. Strive to do each paper equally well.

Latin.—It has been already stated that about one quarter of the candidates fail in Latin. As many of them have been well grounded in it from the first, and therefore pretty sure to pass, it is plain that of those who take up Latin with little or no assistance, after leaving school, the percentage of failure must be very great indeed.

In Latin, as in everything else, a student can do much for himself; the more the better. With books, like Smith's 'Principia' (Parts I. and II.) and Abbott's 'Via Latina,' a book in which every exercise is made with a purpose, a good deal of progress can soon be made. The accidence, vocabularies, rules, and examples can all be mastered nearly as well without help as with it. But to learn to translate Latin into good English is not quite so easy. Much of what passes as translation can scarcely be called English at all. 'The elements of composition are not so much words as phrases, and the English equivalents for these must be found.'

It will be seen, however, that stress is laid on the correct rendering of English into Latin. It would be too much to say that a candidate cannot possibly

learn enough Latin composition by himself to pass the examination; with Arnold's 'Latin Prose Composition,' and the key to it, he might possibly do so. But we persuade him not to try. By all means get a few lessons in Latin composition from a thoroughly competent person, and have your exercises corrected if possible in your presence. Another part of the examination that needs to be borne in mind, is the translation of passages from books not prescribed. Attempt some easy pieces every week. There are plenty of reading books that will answer the purpose. Passages will appear also in these pages as monthly tests. Here are two:—

Vir est virtutis spectatæ, me pœnitet autem vos eum ducem fecisse quia prudentia virtuti impar est et prudentiæ sapientia.

Expugnata Carthagine Scipio circa Siciliæ civitates litteras misit, ut ornamenta templorum suorum a Pœnis rapta per legatos recuperarent inque pristinis sedibus reponenda curarent.

The student who has not begun Greek should consider whether it would not be better to take German. In reading for a degree in science, the ability to read German is of the utmost importance. But if the candidate means to proceed to a degree in arts, he will, of course, take up Greek. Smith's* 'Initia Græca' is a good book for a beginner. It would, no doubt, be well to join a class, and in large towns this becomes more and more easy to do. In many cases private assistance can be got from some educated friend. An earnest student does not require much help, and if it is quite out of reach, he need not despair. *Festina lente*—go slowly—should be the motto all through, but especially at first. Twenty minutes three times a day ought to secure excellent results. Write out all the new words and say them aloud. The forms of the article, nouns, and adjectives must be repeated hundreds of times; they should be occasionally written out, and then compared with the book. A noun and an adjective should be declined together. Such exercises often form part of the questions on grammar.

There is a book which should be used in connection with the 'Initia Græca' from the first. It is so specially adapted to the student's needs, that he must get it at once, and use it every day. It is Rushbrooke's 'First Greek Reader.' We have never known a candidate to fail in Greek, who has carefully studied this excellent book. It is of the utmost importance that the 'unseen passages' should be fairly done. It is not stated officially that this is imperative. But as a man who is weak in Greek will be sure to omit them, or only manifest his ignorance in attempting them, it is easy to see that this part of the examination may show more clearly than almost any other whether a candidate should pass or fail.

A careful use of Rushbrooke's 'First Greek Reader' will make a good examination in this part of the subject certain. There should be no hurry about reading the books prescribed. Of all the unprofitable and repulsive work, surely none is equal to that of trying to read a Greek author before one is fairly prepared for it. Be content to go slowly. Get through most of the 'Initia' and the 'Greek Reader' before attempting the author. Reading will then bring both pleasure and profit.

The subjects included in the paper set on Natural Philosophy are found to give considerable trouble. The paper is now divided into two sections. The candidate must take some questions in section A, and he may confine himself exclusively to them. It is, therefore, very necessary to study some of the many text-books on Mechanics. There is no need to insist on any particular book. We need only mention the names of Newth, Aveling, Magnus, Todhunter, Wormell.

We will return to some of the subjects of the Natural Philosophy paper in detail next month.

(*To be continued.*)

* A Key may possibly be obtained from the publishers by a *bona fide* private student.

Publications Reviewed.

Principles of Hygiene. By Albert Carey F.R.G.S. London: Thomas Murby.

This little book has been composed with a view to the requirements of the Science and Art Department at South Kensington, on the syllabus of which it is modelled. It is simply and clearly written, and is remarkably free from wordiness. The various branches of hygiene are considered in turn, and the more important principles briefly stated; so that the book may be said to give a fair, though necessarily somewhat meagre outline of a very extensive and important subject. We are, however, sorry to notice a number of errors and inaccuracies which considerably impair its value as a trustworthy elementary text-book.

Thus, in chapter i. we find albumen stated to be identical with the serum of the blood, whereas this contains fats and other bodies in addition to serum-albumin. Moreover, the elementary composition of nitrogenous food-principles is not given, although in the next section that of fats and amyloids is alluded to. In the chapter on Diet, too, absolute adhesion is given to Liebig's division of foods into heat-formers and tissue-formers, which is only true with certain limitations. In chap. xi. we are informed that a gallon of ordinary drinking-water contains from two to three cubic inches of hydrogen gas dissolved in it, instead of nitrogen—a mistake which might easily confuse those with a limited knowledge of chemistry. Further on (chap. xv.) it is stated that tea may be 'partly a substitute in badly-fed persons for the nitrogen in animal food.' When we remember the very small proportion of nitrogenous matter dissolved in a gallon of tea, its value as a substitute for butcher's meat will appear very problematical. It is scarcely correct to affirm that theobromine is identical with caffeine, as the formulæ differ by CH_2.

The chapter on Fermented Drinks is spoiled by the introductory paragraph, which would lead the student to conclude that all bodies (such as albumen) which readily undergo decomposition, induce similar changes in more stable bodies, no mention being made of the important part played by certain living organisms in many of these processes. The next chapter, which continues the subject, contains a most extraordinary definition of the peritoneum (which, by the way, is wrongly spelt). In the division treating of air and respiration, the quantity required per hour is somewhat understated. Further, the amount of air deprived of its oxygen by the combustion of one pound of oil is given as thirteen cubic feet instead of over 130; and carburetted hydrogen gas is stated to be present in the atmosphere in the proportion of ·047° which is absurd. In the section on the treatment of those rescued from drowning, we should have been glad to see a less prominent place assigned to the Marshall Hall method, which is now almost entirely abandoned in favour of Sylvester's or Howard's. It would have been well to have added a caution as to the indiscriminate use of emetics in cases of poisoning by corrosives, in which they might sometimes do more harm than good. We

have been sorry to have to call attention to these blemishes in an otherwise excellent little manual; and we still believe that it may by careful revision be made to take a satisfactory place among the numerous similar works which are now competing for the public favour.

Education and Educators. By David Kay, F.R.G.S. London: Kegan Paul & Co.

This book has an attractive title, and the synopsis of the contents tends still further to raise the reader's expectations. It is, however, a very disappointing volume. By far the bulk of the book consists of notes—quotations from other writers. For every word of Mr. Kay's printed in large type, there are at least ten of some other author's in small type at the foot of each page. He says, in his preface, with commendable modesty, that 'the chief value of the book lies in the notes'; but he adds that the text should 'be read by itself, and the notes only referred to when there is something that seems to require further elucidation or explanation.' Now, if he really supposes that every passage of his own to which he affixes a note requires more elucidation than he has given it, he must surely be conscious that his text deserves complete remodelling; for there is scarcely a sentence which is not annotated. If, on the other hand, he does believe the notes to be the valuable portion of the book, his text sinks into insignificance, and should be relegated to the small type, if not dispensed with altogether.

The fact is that Mr. Kay has made the mistake of not quite knowing what sort of a book he wished to produce. He has written perfunctorily and hastily upon a great variety of points, from hereditary transmission to the use of text-books in teaching, and from the importance of pleasing manners to the character of Divine revelation. Conscious, however, that he has only half-treated any of his topics, he seeks to make up for his omissions by emptying the contents of his commonplace book into his pages. The undigested, mixed mass which results has neither the merits of an original work nor those of a volume of elegant extracts. There is little satisfaction in reading the text, because no idea there broached is fully treated and properly concluded; there is less in reading the notes, for the quotations are too brief to have much meaning or value. We do not say that there is not any value in them, for even two lines from the writings of a thinker will be found suggestive, as diamond-dust will sparkle; but just as the value of a diamond is diminished with every cleavage, and comes nearest to nil when the gem is reduced to powder, so the thoughts of such men as Locke, Mill, Herbert Spencer, and Bentham, are depreciated by such unreasonable mutilation as that to which Mr. Kay submits them. A good selection of quotations on education would form a valuable book; but the quotations would have to be long enough to fully express the ideas. Moreover, it would be necessary for the compiler of such a work to avoid another error into which Mr. Kay has fallen, in overloading his pages with truisms and commonplaces. The finest grain must have a proportion of chaff; and, similarly, even great thinkers are obliged, in stating facts or conducting a train of argument, to put forward in due course their axioms and their commonplaces. But nothing can be gained by extracting these and re-dishing them all by themselves as quotations. The case is even worse when one finds some such every-day observation signed only with the name of that gentleman whom the old lady thought wrote most of the best bits in the poetry-books—Mr. 'Anon.' If all this dust were cleared from the pages of 'Education and Educators,' its bulk would be diminished, but its value would be multiplied.

We must now add that we think Mr. Kay capable of doing some useful work on his own account. We differ from him on many of the topics on which he indicates his opinion in this volume. They are not subjects suited for discussion in our columns; for when he speaks of 'Educators' he does not mean the eminent theoretical or practical teachers of the past or present, but uses the word in the far wider sense of 'whatever calls a faculty into exercise, and so trains or educates it.' His scheme, therefore, leads him very widely away from what is ordinarily meant by education—viz., school, or college, or tutorial teaching—and into fields where we, as teachers, cannot follow. Discussions on Capital and Labour, on the theories of Mill's Liberty, or on Divine Grace, do not come within our review here. But we may say that, however we disagree with some of Mr. Kay's conclusions on such points, still his method of treating them is such as to lead us to believe that he might write much more usefully than he has done here. In order to do so, he must throw away his crutches—his notes. Let him gather ideas from his commonplace book, but let him not make use of it to excuse himself from thoroughly writing out his subject from his own mind; and he may yet do some excellent work. The composition of this book is scholarly, the author's reading evidently covers a wide range, and his tone is earnest and sincere.

School Management and Method in Theory and Practice, etc. By John J. Prince. Manchester: John Heywood.

This book is written by a practical teacher who has kept his eyes open while about his daily work. Having mastered its details, and acquired definite ideas regarding the several departments and processes of school-keeping, he here presents the results of his observations and practice for the help of young teachers and others, 'intending to sit at the scholarship or certificate examinations.' The book fully justifies the assertion in the preface, that 'it is practical in the full sense of the word.' It is one of a useful class of books which have come thickly upon us of late, written by workers, for workers, and especially to enable candidates 'to answer successfully the questions which may be proposed to them at the examinations for scholarships and certificates.'

Such books, when well written, serve a useful purpose. They deal with the art and practice of school instruction and management, and they give the information needed for answers to the questions proposed at the examinations. Written less for the purpose of setting forth a true standard of education than of meeting the requirements of the Code, they do not, as a rule, present a view of the science of education in its broader aspects, nor indicate the principles, save incidentally, on which true methods of instructing and of training children depend.

Many who take up the profession of teaching limit their aims to the acquirement of just as much knowledge of school work as will enable them to satisfy the conditions of public elementary school teaching. As a guide to the reaching of such a standard this book seems well adapted. It contains much information, and some thoughtful and intelligent observations on the several matters comprised in the work of a day-school teacher, for the most part sensibly and clearly put. It also indicates, with much directness and precision, methods and rules for the management and teaching of children, which have been found effective in practice, and which characterise many successfully-conducted schools.

The matter is arranged in four parts: I. School Management; II. Method; III. Investment of Savings, Building Societies, Sanitary Science; IV. Examination Questions, with Hints and Answers.

The chapters in Part I. deal successively with the schoolroom, organisation, registration, and discipline. The practical good sense characteristic of the book marks *most* of what is given under these heads. There are, however, some doubtful exceptions. Thus, in section 36 (pp. 47-8), headed 'Cleanliness and Neatness,' there occurs this direction, oddly worded, and of questionable propriety: 'The children old enough to keep themselves clean, should be always kept in, similar to late scholars, for about three-quarters of an hour, and *not permitted either to speak or move.*' (The italics are ours.)

Again, some good counsel regarding corporal punishment is followed by this statement: 'The front of the hand is the only part upon which the punishment

should be inflicted.' In view of the nature of the punishment itself, of its emphatic condemnation by many medical authorities, and of numerous recent magisterial decisions, it may at least be urged that this *dictum* should be received with the greatest possible caution.

Part II., on Method, traverses the ground usually covered in the treatment of this subject. After a chapter on 'Class Teaching,' come those dealing with the common school subjects of instruction, including geography, grammar, and history. There is not much originality displayed, and probably the book is none the worse a guide for that. The recognised modes of teaching are clearly stated, various methods for the same subject discussed, and the whole supplemented and strengthened by the results of the writer's own experience and practice as a teacher.

Part III. gives information on the investment of savings, building societies, and sanitary matters. A knowledge of these matters is valuable, and is much less widely diffused than it should be. Its direct bearing on thrift and on health gives it special value as subjects of school instruction, and such an account as is here given of the first and second named, is not commonly accessible. This may be held to justify its insertion in a work on school management, in which we ordinarily expect to find rather the method of teaching a given subject, than a treatise upon it.

Part IV. furnishes exemplar answers to questions, or indicates to what part of the book to look for the matter of these. More than one hundred and fifty questions are thus dealt with, taken from Government examination papers on all the subjects.

Concerning the style in which the book is written less that is satisfactory can be said than of the matter. The confused mixture of the second and third person in the same paragraph, or even in the same sentence, pronouns jumbled together, and referring to antecedent nouns or clauses so distant as to be puzzling, or even to no clearly traceable antecedent, inaccurate use of words, and other errors of style abound. What else can be said of sentences and phrases like those which follow?—

'This stimulates the children much, as none like to be left behind, if possible.' 'This is the duty of the time-table.' 'It is no use to provide a change of position for any class on the time-table, without the room admits of it.' 'The teacher must . . . . see . . . . that the children have assimilated and digested the instruction' [a sequence of processes about as likely as that of food being swallowed and chewed!]. 'The teacher should call for slates, and examine them, telling them who are right, etc.' 'He must also show them that it is a part of social duty to be neat in their dress, boots laced up, and clean.' 'In teaching problems the scholars should commence with very easy ones, that they can work mentally, and make them give a reason for every operation they perform,' etc.

'Do not, by appearing to countenance something one day, punish the doers on another for the same action. If you disapprove of it, let it be shown at first. Whatever few laws and regulations you have laid down for the government of your school should be rigidly adhered to. It must be like the happy remark of Mr. Spencer,' etc.

Does the punishment referred to in the first sentence of the last paragraph consist in 'appearing to countenance something' . . . .? What is the 'it' which 'must be like the happy remark'? Is it the 'it' of which 'you disapprove'? or is 'it' the 'laws and regulations'? How, in either case, can it be 'like a remark'? It is greatly to be regretted that a book containing so much that is good and sensible should be so faulty in style. That it should be so written by a teacher is marvellous.

Among minor faults are a disfigurement of the book by the many footnotes directing attention to 'advertisements at the end,' and the verbal errors which have been overlooked. A curious example of the latter occurs on p. 61: 'Nothing tends to destroy the confidence placed in a teacher more than *impartiality*' (!).

The Child's Bible Expositor. By S. E. Scholes. Manchester: John Heywood.

We suspect that this is a somewhat ancient book, refurbished as regards binding, but in no way altered in its old-fashioned interior. It reminds us of the sarcastic observations in the Report of Lord Sherbrook's Commission on Education in 1862, about how children in the old-time denominational schools were often far better instructed about the journeys of the Israelites and the structure of the tabernacle than they were about matters of the present day. This little book is a paraphrase of the Bible, chiefly of Old Testament history, put in the form of question and answer. Not a detail is omitted here. For instance, we have solemnly given, for learning by rote, we presume, such paragraphs as the following:—"Adoni-Zedek, king of Jerusalem; Hoham, king of Hebron; Piram, king of Jarmuth; Japhia, king of Lachish; and Debir, king of Eglon." We doubt if there could be found anywhere, now-a-days, even amongst the most old-fashioned Diocesan Inspectors, one who would ask for memory-work such as would be involved in learning bits of information like the above. Sometimes, the questions and answers here read very quaintly. 'Of what sin was Solomon guilty?' 'Having too many wives—a thousand altogether.' 'Was not this inconsistent on Saul's part?' 'Yes...but now anxiety and fear evercame every other consideration.' 'What is meant by "darling"?' 'My precious life!' Original information, such as the last, is occasionally given, but not always accurately. Thus, we find—'What is the palsy?' 'A disease *by which the nerves are contracted!*' Again, we have 'the miracle of the sun standing still' unjustifiably corrected into 'the earth to cease from her diurnal motion.' On the whole, we can regard this book as doing but little else than enabling us to realise how far education has advanced. So immeasurably have school books improved of late years, that a high standard of criticism has now to be applied to them; and few books prepared in the era before the establishment of national education stimulated authors of repute and ability to work in this field, are found able to rise up to the present standard. We fear this 'Expositor' would not now be of much service either to teachers or scholars.

The Stocking-Knitter's Manual. By Mrs. George Cupples. Edinburgh: Johnstone, Hunter and Co.

This useful little manual hardly calls for review; the fact that its sale has reached the 110th thousand is a sufficient testimony to its merits. We will not say that any one could learn to knit from its pages, for the mere making of the stitches is not attempted to be taught, and, indeed, is hardly teachable by words alone: but any person who can do the simple plain and purl stitches may learn from this little book how to turn such ordinary knitting into socks and stockings of every variety of size, shape, and pattern. Besides concise and clear directions for such small mysteries as turning the heel, working the toe, and so on, we find several patterns illustrated by engravings, for knitting openwork stockings. Cotton stockings are comparatively seldom knitted; they certainly take a long time to do, but their comfort and durability are beyond all praise, in comparison with woven ones. If knitted according to some of these pretty openwork patterns of Mrs. Cupples', stockings made of tolerably coarse cotton would be suitable for the warmest weather. We consider knitting one of the most useful parts of the needlework taught in our schools. Most garments can be machine-made to wear as long and as comfortably as though hand-made. But stockings both wear better and fit nicer when knitted than when made by any machine yet invented. Moreover, the work-woman can read, talk, or walk if she wishes, while knitting; the constraint of it is thus much less than that of any other kind of needlework, and busy wives and mothers can fill in odds and ends of time with it. Mistresses of elementary schools may thus begrudge the hours they spend in teaching this useful and pleasant avocation less than they may do those expended on

teaching *fine* back-stitching, Swiss darning, marking, and the other varieties of needlework that they know working-men's children neither ought to nor will make real use of in after-life. Mistresses having to deal with large classes of girls who already know how to knit, but are not very sure of the number of stitches required to form the different sizes of stockings, the places for the intakes, and the methods of forming the heel, will find that they are spared much trouble by having recourse to Mrs. Cupples' practical and useful little manual, in which every such detail is fully set forth.

Two Saxon Maidens. By Eliza Kerr. (Illustrated.) London: Wesleyan Methodist Sunday School Union.

Miss Kerr has very considerable powers of narration and imagination, but we cannot but think it unfortunate that she should have employed them upon so unpromising and difficult a subject as a story of Saxon days. The first of the two maidens referred to in the title lived in the eighth century, contemporary with the Venerable Bede. She has a very objectionable relative, who is, of course, a Pagan, and who seems to amuse himself by doing everything that he can devise to frighten the poor little maiden. He imitates a were-wolf, for no other object than gratuitously to scare her nearly out of her wits; and when he is interrupted in the forest in the course of this performance by the arrival on the scene of the Venerable Bede, who carries the child to his monastery for restoration, the heartless Pagan avenges himself on the good monk by stealing his translation of St. John's Gospel. There is a good brother of this villain, who recovers and restores the MS. If the idea was to represent the good influences of Christianity as opposed to Paganism, it is not well carried out; for both the brothers are Pagans till near the end of the story, and yet one is vicious, the other moral and pious, to the same extent all through. The good brother becomes a Christian, but this does not prevent him from saying in the most unchristianlike way to his dying Pagan brother—'If you do not die, I will slay you with my own hand, to rid the earth of such a monster!' The maiden 'murmured feebly' that such language was unbefitting a Christian; and Affa said he was sorry for using it, at the moment that his fainting brother, the monster, proved the threat superfluous by dying.

The second story is both longer and more complicated. It is laid in the time of Alfred, and Danes pervade the scene, which is bathed in blood on nearly every page. No doubt, there was a good deal of fighting in those times; but people did not live always in the midst of killing and slaying. Wherever men have subsisted, they must have spent far more time in cultivating their land, in tending their flocks, in guarding against the ravages of the wild beasts, in domestic avocations, in fishing the streams, and the like, than in shedding each other's blood; but in this book, battle and rapine are the constant theme; and we cannot think it an improving one. They are very lady-like fights, too, without even the merit of being stirring and realistic. Twice in the book, at least, a Dane who has been lying for dead, turns out to have been 'playing 'possum,' and rises and glides away so suddenly that his astounded enemies 'have no time to stop him;' this is a specimen of the realism of Miss Kerr's endless battles.

Extraordinary powers of imagination and profound study are both required to make an historical novel successful; and Miss Kerr has not here given proof of possessing either qualification. Nevertheless, she displays so many good qualities as to assure us how much better she can do if she will write of what she sees before her eyes. The style is easy and flowing; many of the descriptive passages are written with a keen sense of beauty and great power of expression; and the characters have vitality and interest. What is wanting is a *story*, and suitable *detail* in the telling of it.

The Good-Natured Man: a Comedy. Goldsmith. London: Blackie & Son, Old Bailey.

This comedy has been prepared for use in elementary schools, and a life of Goldsmith and full notes to the play have been added by H. Littledale, B.A. Where a play is selected as one of the reading books for the higher standards, this will be found easier to prepare than one of the longer and more difficult plays of Shakespeare.

Home-Lesson Books: Blackie's Historical Readers I. and II. London: Blackie & Son, Old Bailey.

Every available aid in preparing for the annual inspection is eagerly sought. With three reading books to prepare in each of the higher standards, much of the matter naturally escapes the memory, and 'refreshers' are continually needed. These little books will serve the purpose very well. They contain lists of the difficult words in each lesson, with meanings to the most uncommon, and a well-written summary of the narrative of each chapter. At the end of each book is a table of the chief events and dates comprised in the period embraced in the book. They can be cordially recommended.

Appropriate and Varied Occupations for Infants. By J. E. Singleton. London: Jarrold and Sons.

This book, as its title implies, is prepared for the help of teachers in providing 'Appropriate and Varied Occupations' for the scholars of Infant Schools, as required by the Code of 1882, Art. 106 (*b*) 3.

The requirement thus phrased awakened some anxiety, and gave rise to much discussion on its appearance in the New Code of 1882. To some it conveyed the idea of Kinder-garten exercises only; to others little more than the 'Physical Exercises' of former days, accompanied by singing—now known as 'Action Songs', with marching and playground exercises.

Between these extremes, and uniting both, there is room for much play of ingenuity and tact on the teacher's part, in devising and carrying out a scheme of exercises which shall at once fit in with the necessities of child life and the educational requirements and opportunities of the school. Such a scheme is here provided. It presents a series of occupations, very varied, for the most part highly 'appropriate,' which, if neither 'complete' nor 'exhaustive,' as modestly disclaimed in the preface, is yet admirably suggestive, and in the hands of a true teacher can hardly fail in thorough effectiveness.

The book is divided into two parts. Part I. comprises Occupations proper, Singing, Drill, and Technical Employments of the simplest kind. 'The object is to institute regular organised educational play by simple means.' This excellent purpose is carried out by utilising a child's natural propensities as shown where opportunity is given, in the construction of pebble heaps, sand houses, and the manufacture of mud pies, etc., and by developing its ideas of form, recognised by the rude drawings of houses, animals, trees, and other objects which children so much delight in attempting.

Singing is dismissed with the simple recommendation of Action Songs, now so largely provided for Infant Schools.

Drill is elaborated by a careful detail of various bodily movements, many of which are common in good Infant Schools, here symmetrically arranged and prettily illustrated by outline drawings of children in the various exercises.

Much more attention is given to 'Technical Employments.' This is a highly valuable feature of the book. Much ingenuity and good sense are shown in ball-frame occupations, sticklaying, domino arrangements, drawing, pricking, 'pegging'—another name it seems for the Kinder-garten 'pea-work'—brick-building, modelling, paper-work, string manipulation, and other varieties of interesting and useful occupations. Kinder-garten

exercises of various sorts are well employed, without a slavish adherence to the ordinary book instruction on this subject.

The active ingenuity of the author is perhaps unduly exercised in the 'construction of figures' with balls on the frame, which are not free from confusion to the eye of adults, and which would be puzzling to most infants. They would be certainly difficult, if not impracticable of formation by them, and of small value when done. But with few exceptions the exercises are thoroughly good. How to use the different materials, what to aim at, and the practical application of all to other school purposes, as reading, writing, arithmetic, etc., or the common purposes of life, are well shown.

Part II. is designed to provide 'Conversational Lessons, with suggestive appropriate and varied occupations associated therewith.' There are *one hundred* such lessons, the subjects well selected, on Objects, Common Phenomena of Nature, and Natural History. Each lesson has a number of 'associated occupations' supposed to have some natural connection with it, or to be suggested by it. Thus, with the lesson on Coins are associated the occupations of modelling, drill, paper designing of various sorts, exercises on number, with ball-frame and dominoes, stick and strip laying, sundry games, drawing and pegging. And so, in greater or less variety of employment, of all the lessons.

A point suggests itself as to how these various occupations are to be combined with the lesson. No mention is made of the difficulty of preventing undue distraction of attention through the introduction of the exercises, nor is it definitely stated whether all the scholars are to be employed in them at intervals during the progress of the lesson, though such would seem to be the intention; if so, it would be interesting to know how the materials are to be distributed and dealt with; whether one occupation only is to be used at the time of giving the lesson; and whether the lesson is to be repeated and revised each time an associated occupation is engaged in, and so forth. There seems some risk of spoiling two good things in the attempt to combine them. In the very frequent case of large classes the handling of so many different things must be fraught with risk to any but skilful teachers. And no sufficient indication is given as to how these and similar difficulties are to be met.

Yet the methods indicated in the earlier part of this book and the ideas pervading it throughout are highly suggestive, and the whole forms a valuable contribution to the large number of recent books put forth for the guidance of teachers in this department of Infant School work.

Physiography: Johnston's Standard Series of Illustrations. Sheets I. and II. London: A. Johnston.

We feel we are doing the teaching profession a good turn in recommending to their notice these two capital wall-sheets. They are vigorously designed and coloured, and will form most valuable auxiliaries in impressing the main facts of physiography on the minds of youthful learners. Sheet No. I. deals with coal, coal mines, volcanoes, and geysers, and the illustrations which have been selected as representative of these subjects are well calculated to awaken and sustain the interest of the class. Sheet No. II. is devoted to Physical Geography, and treats of the subjects therein comprised in an equally happy manner. The two sheets, taken in conjunction with the explanatory keys issued with them, will afford to teachers the subject-matter of a series of lessons as full of instruction and worth as they are of interest.

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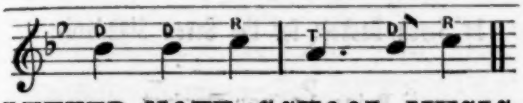

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